PRINCIPLES OF HEALTHFUL LIVING

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PREFACE

TEN years ago, upon the suggestion and with the advice and co-operation of Dr W W Charters the author undertook to collect data which might illuminate the present, and the probable future, health needs and health interests of young people This involved him in a number of procedures, among which were the following (1) collecting spontaneous questions raised by the young people themselves in courses in hygiene and related fields, which the author obtained through correspondence and in his relationships with students, (2) examining the reports of research workers in the field as they have appeared from time to time in publications, (3) collecting the problems cited in health columns conducted by physicians in American newspapers, (4) checking constantly the reactions of students to the topics presented by the author in his classes, (5) studying the opinions of experts in the subject as revealed in textbooks and articles in magazines and journals, and (6) examining the data secured from the physical examination of college students and the day by day dispensary and infirmary records In all more than four thousand 'problems' were collected and organized into their major groupings These data have helped determine the content of the course upon which this volume is based

Knowledge in the fields of health and of disease prevention extends into many areas of human interest and activity A functional course in the principles of healthful living involves a presentation of basic information in the related fields of anatomy, physiology, hygiene, bacteriology, immunology, sanitation, and preventive medicine But if this information is to be of real value in the lives of students, it must not be offered as an end in itself it must be presented to the student as a means of attaining a richer and fuller life It is not the attempt of this book to develop specialists in hygiene, and therefore technical terminology has been introduced only where it has been indispensable for an understanding of the principles of body functioning

This book deals primarily with problems in individual or per

fessor Wilma Haynes, and Professor Minnie May Johnson, to Dr F G Nifong and Dr W B Brown, and to Miss Elizabeth Benson, Miss Dorcas Lindsey, and Mrs Jewel Somerville

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E. F V B.

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PRINCIPLES OF
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INTRODUCTION

GETTING OUR BEARINGS

1. AIMS AND SCOPE OF OUR STUDY

Why go to college? A college career is an enterprise of significance Experience has abundantly shown that we are more likely to succeed in any important undertaking if we know beforehand what our objectives are and what will probably be needed in order to accomplish them If we apply this principle at the start of a college career, we ask ourselves why we have come to college and what, in all probability, our years at college will cost in the way of time, money, and effort

The answers given to the question, "Why go to college?" by young people themselves, indicate certain hopes, beliefs, and attitudes of mind Some students have a definite objective in the way of preparation for some particular kind of life work Others are undecided, although they have in most instances some idea of the types of work that appeal to them as interesting possibilities Many want to investigate more than one vocational field before making a definite choice, and the first two years of college are commonly designed to afford opportunities for this type of experimentation All students expect to find opportunities for further development which they believe will contribute in an important way toward success in life no matter what vocation they decide to enter

Why mention these facts as an introduction to a course in the study of health? The answer is clear a course in health should make valuable contributions to the attainment of success in college as well as in after years If it does not help you in college, it fails to accomplish one of its most important objectives Natu-

cold from him, become seriously ill, and thereby cause loss and suffering to his family Whether we like it or not, we are our 'brothers' keepers Inevitably what we do affects others and their behavior affects us.

The scope of our study There are many fields of knowledge basic to an understanding of the principles of healthful living *Hygiene*, which may be defined as the science of health, and *sanitation*, which deals with the control of environmental factors that influence the maintenance of health and the prevention of disease, are both fundamental to our study The field of hygiene is frequently divided into *individual hygiene* and *group hygiene* These two aspects of the science of health are inextricably interrelated Since society is composed of individuals, the only way to raise the level of group health is to improve the health of the individuals within it. We shall deal with both of these fields, although since this is an introductory book upon healthful living the emphasis will be placed upon individual hygiene Basic to an understanding of both individual and group hygiene is a knowledge of the human body its *anatomy*, or structure, and its *physiology*, or functioning

Life involves interactions between an *organism*, which is the term applied to any and all forms of life, and environmental factors For this reason our study cannot be limited to a consideration of the human body as if it existed apart from its environment, we must also examine the factors in its surroundings with which it interacts Certain aspects of the environment are *physical*, or nonliving, others are *biological*, or living elements. Some of the more obvious physical factors are air, water, and foods In the study of their interactions with the body it will be necessary to make use of certain facts of *chemistry*, which deals with the composition of matter and the changes occurring within it, and *physics*, which is concerned with the study of *energy*, which is the ability to do work Examples of energy are motion, heat, light, and electricity

The biological aspects of the environment are of equal impor

tance with the physical, for other living things affect us unceasingly and we in turn affect them One of the biological sciences with which we shall be particularly concerned is *bacteriology*, the study of bacteria, inasmuch as some of them produce certain diseases Since bacteria are forms of plant life, in learning about them we become acquainted with one field of *botany*. We shall have occasion to learn something about plants in other ways as well, for example, in our study of the foods manufactured by green plants Certain facts of *zoology*, the science of animal life, will also be drawn upon There are some forms of animals as well as plants that may live in the human body and cause disease

Of course, the most important living things which affect us are our fellowmen Therefore our study deals at times with various aspects of *sociology*, the science which treats of society Finally, the field of *psychology*, which is the study of behavior, has a direct relationship to health, and we shall have occasion to refer to some of its findings

The above listing of certain fields of science which are related in very important ways to the principles of healthful living is by no means complete, but it will serve to show the diversity of the interrelationships in the study we are undertaking It may be well to state that we shall not approach any of the branches of science as specialists We shall not even attempt to obtain a comprehensive view of any of them except possibly human physiology, and then only in an elementary manner

A guiding principle in the choice of material in this book has been practical value In using this criterion it has been our intention to select topics which also have a high cultural value Cultural values include appreciation of the beautiful When the mechanisms of the body are understood, they are seen to possess rare beauty in the delicacy of their adaptations, their precision, and in the harmony of their functioning A knowledge of them may well inspire awe and delight

Limitations of health knowledge In spite of the assistance of so many specialized sciences in helping to solve the problems of

health, we are far from having complete, or even satisfactory, answers to all questions relating to our subject As a matter of fact, each of the branches of science mentioned is a going concern in the sense that discoveries are constantly being made which modify old ideas and techniques as well as establish new ones. The confines of knowledge are ever being expanded, but the field of the unknown is vastly greater than that of the known It is important to recognize that science cannot answer all our questions and that many of our answers must be regarded as either tentative or partial If we understand this, we shall not expect the impossible since we shall understand also that, in many aspects of our study, we are standing on the threshold of unexplored regions

There is another complicating factor in getting answers to questions relating to health and disease Whereas all human beings are in certain basic respects alike, they nevertheless differ markedly in many ways. "What is one man's meat is another man's poison," is true in this field as well as in others. For example, some people are immune to diseases to which others are susceptible There is probably not an article of food that agrees with everyone The amount of sleep needed by individuals, even of the same weight, sex, and age, varies We can hardly lay down any health rule without adding that there may be exceptions It is also a matter of common knowledge that any particular individual varies at different periods of life in regard to what constitutes a desirable health regimen Individual variations appear to result from factors the exact nature of which, in many cases, has not as yet been determined

From the above statements it may appear at first thought to be a waste of time and effort to attempt to formulate any general hygienic principles But this is not true In basic respects human beings are much alike Therefore, it is both possible and worth while to formulate general principles of healthful living and make intelligent use of these simple rules in our daily lives

Prevention better than cure Most people are not interested in the functioning of their bodies until they become sick, or until someone near and dear to them experiences an illness and perhaps dies This is natural but it is unwise If the organs of our bodies are functioning normally, we usually pay no attention to them To a certain degree this is desirable Some people are so fearful of becoming ill that they actually worry themselves into illness Such persons frequently have a smattering of information about health and disease—just enough to make them apprehensive If they had more exact information, in most instances their minds would be set at ease We are not referring here to cases where medical attention is really needed Under such circumstances it may be well to do a little worrying, provided it leads to intelligent action that is to securing reliable medical advice or treatment

How then are you to know if you are really ill or just imagining it? Pain and discomfort are symptoms of trouble However, there are, unfortunately, some disorders which give little or only indefinite indication of their existence until a more or less serious condition has been established Some elementary knowledge about the early signs of such illnesses and what can be done to check certain diseases that are insidious in their development, is very useful since it leads to early treatment which frequently saves lives One of the fundamental purposes of this book is to provide you with this kind of information It is a safe rule to seek medical attention at any time that you may need it, but you should have a good sound reason for seeking medical advice

Health as an aim in life There are different ways of evaluating good health To some people health is the greatest possible good—something to which everything else must be sacrificed Certainly good health is worth striving for However, we should desire good health not merely from a selfish point of view, but rather because of its social value The desire for health at all costs may become an evil, a menace to the best in life, but as a means of

worth while achievement it is greatly to be desired When we are feeling well, we can make better social adjustments, we are better companions, and we can accomplish more with less effort

What is meant by the statement that the attainment of health, when viewed as an end in itself, may be an evil? Merely that at times there are more important things to consider than the possible danger of becoming sick Thus, a parent may give watchful care to a sick child to the detriment of his own health, and a doctor or nurse is frequently called upon to brave health hazards in the performance of duties As a general rule, however, the protection of our physical and mental efficiency is in harmony with the performance of our highest duties and privileges Although we admit that exceptional occasions may call for the temporary disregard of the facts and principles of healthful living, at the same time we should also clearly appreciate the fact that good health ordinarily constitutes an important means of attaining a richer and happier life

II A COLLEGE HEALTH PROGRAM

Major features of a college health program After this brief survey of the aims and scope of a fundamental course in the principles of healthful living, let us consider how it may assist you to obtain the maximum benefit from the general health program of the college Although colleges differ in respect to the details of their health programs, their general activities in this field may be discussed under four heads (1) the Health Service, by which is usually meant medical and nursing attention, preventive as well as curative in its nature, (2) the maintenance of healthful living conditions, (3) health instruction, and (4) the activity program For a program of this kind to function effectively there must be an understanding of its various phases both in the thinking of the student and in the administrative set up of the college itself

Health service Many colleges afford splendid facilities for service to individual students in the fields of preventive and curative

the feet, general muscular tone, and the condition of the nervous system are also examined, and, if necessary, corrective measures are prescribed or recommended Some institutions test for the presence of tubercular infection—past or present—and students who have not been vaccinated within the last five or six years are immunized against smallpox If a student reacts positively to the test for tuberculosis, an X ray examination of the chest is made or recommended to ascertain whether the infection is an active or an old one that has healed Furthermore, records of age, height, and weight are made and, upon the basis of these findings, recommendations may be given about diet, in some cases a basal metabolism test may be provided

Upon the basis of the student's medical history and upon the findings of the physical examination, it is customary to rate each student as to the amount of physical activity permitted Most students are given unlimited freedom to engage in competitive sports Some are restricted to milder forms of exercise, and a small percentage—those who, for the most part, are convalescing from major operations or serious illnesses—are placed temporarily on a rest program If a serious condition is found, it is necessary to acquaint the student's parents with the findings of the examination and to make certain recommendations

The amount of initiative taken by the Health Service in carrying out a program of the kind outlined above will vary with the type of institution and with the facilities available The details of carrying out certain of the corrective measures will be the responsibility of other departments of the college, such as the Dietary and Physical Education departments, which are usually closely associated with the Health Service

Much of the work now carried on by university and college health services is a recent development There are many colleges of high standing which for one reason or another have not developed the completeness of program we have outlined It is, however, reasonable to believe that, as the need for this kind of service becomes more generally known, additional provision will

be made for it Whatever the health service activities of your college may be, it is the part of wisdom for you to become acquainted with the facilities offered and to make intelligent use of them as needed

Maintenance of healthful living conditions The living conditions of the college are the responsibility of (1) the college authorities, (2) the community, and (3) the student

The college is responsible for providing sanitary housing conditions in all of its buildings These include cleanliness, proper heating lighting, plumbing, and, if meals are served, food which is scientifically selected and attractively served Adequate supervision of student rooms includes inspection at regular intervals and the prompt correction of bad living conditions wherever they are found In addition, the college should assume the responsibility of selecting and supervising boarding houses where students live

The college should demand of the community adequate inspection of food milk that has been produced and distributed under sanitary conditions, and modern methods of sewage disposal The community also has the responsibility of maintaining decent and wholesome conditions in the streets, parks, restaurants, hotels, barber shops, beauty parlors, and in theaters and other places of amusement Although a perfect community environment cannot be found anywhere and should therefore not be expected, the college, the students, and their parents are justified in demanding that adequate attention be given to safety, health, and decent living conditions

The degree of orderliness and cleanliness which you yourself exercise in your daily living will go a long way in determining the kind of conditions under which you live A bedroom should be kept orderly and clean You should not keep in it food which deteriorates easily, such as milk or meat products When a box comes from home, be sure that any quickly perishable food, like chicken, is in good condition, and also protect its contents from flies and other insects, and from the mice which are so apt to be dormitory companions It is wise to discourage parents from send-

ing such foods as meat and poultry which are apt to deteriorate in transit If you indulge in food between meals, fruit is not only the safest to keep in your room, but the best for you to eat

Health instruction A third aspect of a college health program is the provision for health teaching Some of the courses in which one or more of the phases of the principles of health are treated are Hygiene, Human Physiology and Anatomy, Home Economics, Bacteriology, Nursing, Child Care, Zoology, Biology, Genetics, Psychology, Mental Hygiene, Sociology, and many courses in Physical Education The work done in speech clinics also has health significance

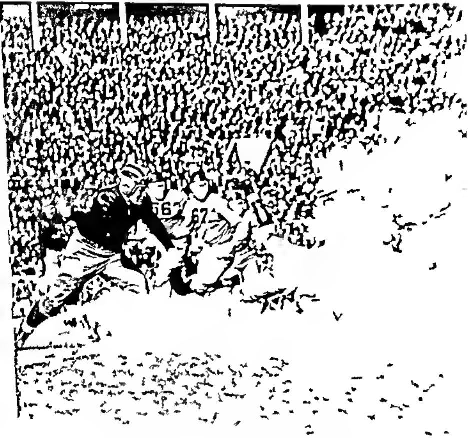
Physical Education is of special value in the health program of a college Part of this work is carried on as regularly constituted courses in the curriculum and part is extracurricular The required work in Physical Education deals for the most part with the development of certain skills, such as those needed in playing games Whatever health teaching is given is usually of a rather informal type However, this incidental teaching is often the most effective, since it is apt to be tied up with the interests of the student In certain special courses in Physical Education, however, as, for instance, in the field of correctives and in advanced courses intended primarily for Physical Education majors, there is often a great deal of the formal type of health instruction

In spite of the many opportunities for acquiring knowledge in healthful living that are offered at many colleges today, the fact remains that a large proportion of college graduates have never enrolled in a course which has this for its chief objective Courses in Hygiene should supply this information It is to help meet a need of this kind that this book has been written

The activity program—a means of promoting health The close and vital relationship between physical education activities and health is self-evident On the other hand, the relationship existing between the many varied activities making up college life and the health and well being of students has not been appreciated until recently either by students or by college authorities. The modern

Some colleges afford opportunities for friendly interviews between individual students and physicians.

A well made bed is conducive to relaxation. The technique of bed making is explained in Home Hygiene courses



A scene wh ch may be duplicated in the fall of the year in many parts of our country (Acme)

isfied that the course he has chosen is the best for him. Definite opportunities may also be afforded the student to see his instructors, and to talk over with the dean any personal problems which may have arisen. If it seems desirable the student may be allowed to change his program in the light of experience with the courses he has chosen. If this consulting service is carefully and wisely conducted, there is ample reason to believe that it makes possible, in many instances, the avoidance of much unhappiness and maladjustment sometimes encountered by students later in their college career

In spite of the fact that it requires a considerable amount of good judgment to strike a nice balance in determining what one will do and what one will not do, most students find no great difficulty in making at least fairly satisfactory adjustments. The result is that most young people find college life enjoyable and stimulating For various reasons, however, a considerable percentage of students fall markedly short of obtaining the degree of growth and personality development which they might obtain from a college education. Let us briefly consider three types that come within this category, remembering of course that there are many reasons for maladjustment and failure, and that it is impossible to do more than describe a few

First, there are the individuals who attempt too little Such students are frequently the over sensitive ones who, because they do not immediately attain the degree of success or recognition they think they deserve, "crawl into their shells" and attempt to "get by" with the minimum of effort Sometimes a boy or girl who has won considerable prominence in high school becomes discouraged, and gives up trying because a corresponding degree of success in college is not immediately attained. Perhaps the discouragement is due, in part, to failure to be invited to join some particular fraternity or sorority, or perhaps to disappointment in not getting better grades Whatever may be the cause, this type of student may come to feel that his fellow students or certain members of the faculty do not appreciate him and perhaps even

have it in for him A frank discussion of the problem with a friend just a little older, or with his adviser, may give the help needed to assist him in 'snapping out' of the doldrums

Second, there is the opposite type of student He is, of course, the individual who attempts to do too much and develops a case of mental—or perhaps actual—indigestion This student is constantly in a jam and sometimes, as a result, injures his health He easily evolves into the kind of person who, upon finding that part of what he is doing is easy and to his liking, neglects to carry on those activities which may be of primary importance, and most significant for his future success He then becomes the third type of maladjusted student, the one whose program lacks integration and balance Students of this type are usually to be found among those who come to college chiefly to participate in athletics, or who devote an excessive amount of time to social affairs However, just as flagrant examples of lack of proportion in the use of time may be found among book worms who will not take time out for recreation or companionship A careful consideration of what your college has to give you will show you that it is possible to take a serious attitude toward your studies and at the same time get a great deal out of extracurricular and social activities

We have been considering some of the types of students who are not well adjusted to college life What are some of the specific evidences of maladjustment? The most common are poor work, over fatigue, lack of interest, unsocial behavior, and emotional disturbances When these conditions are analyzed the causes underlying them are found to be various even in individual cases In some cases the college can and should do something about them In other cases the college is not responsible for, and cannot change all of the causative factors, although it is often possible to help the student take a more wholesome attitude toward them

Among the most common reasons given by students as to why they are maladjusted are the following not knowing how to study effectively or budget time properly, worry about their

work or about home conditions, unhappiness in love affairs or in sex social situations (i e, situations in which both social and sexual problems are present), financial worries, and difficulties of one kind or another with certain instructors or with their fellow students

The conditions mentioned above call for some sort of corrective mental hygiene treatment It is evident that some kind of mental hygiene program which extends throughout the whole year and is not limited to the first week or two of college is desirable Some types of maladjustment are frequently rather easily corrected For example, valuable advice in methods of study, in budgeting of time, and in getting along with other people can be given to a student without necessitating the services of an expert in human behavior If the student's adviser has the time, and a true friendship is established between adviser and advisee, much that is worth while may be accomplished through regularly scheduled interviews However, certain behavior problems can be dealt with effectively only with the assistance of experts. Some institutions have accordingly established Mental Hygiene Departments with carefully selected personnel These departments are usually a part of the Health Service, since experience has shown that many personality difficulties have their origin, at least in part, in physical defects which only a physician is competent to diagnose and treat

The inability of a student to carry on successfully the academic work of the college is often only an incidental part of the picture It may be a symptom of the existence of a much more significant problem in his life College authorities are gradually coming to see that, once having accepted an individual as a member of its community life, they have assumed certain responsibilities for helping him to meet life situations successfully in their broader aspects and not merely in relation to college work When the college helps a student to solve wisely a difficult problem in his personal life, it is doing in many instances, the only effective thing that can be done to correct his academic difficulties

The student must recognize that he himself, not the college, is primarily responsible for the use he makes of his time and energies The college cannot guarantee success to everyone, any more than success in business or professional fields can be assured to all who enter them The student must learn to assume a fair share of responsibilities, if he is to complete his college course successfully

Attitudes that are helpful In closing this chapter let us mention two attitudes which the experience of many students has demonstrated to be helpful The first of these is being friendly and receptive to new ideas, the second is foresightedness

No one knows all the answers, and you should not go to college with the expectation of getting the final word on all questions, but rather to broaden your interests and ideas Be open-minded to new ideas if sufficient reasons are advanced to justify their acceptance, but do not change your ideas and ideals and adopt new ones just because they are different The "I m from Missouri—you ve got to show me!" attitude has much to commend it, provided it induces an intelligent evaluation of whatever is new, and provided it does not carry with it unwillingness to modify your present beliefs, habits, attitudes, and outlook on life, even though the heavens fall It is well to recognize the fact that your fellow students come from many types of homes and backgrounds, and that their behavior is the result of previous experiences and hereditary influences just as yours is, and that therefore everyone is different since no two individuals have identical backgrounds

The second attitude, namely, that of foresight, needs to be cultivated by everyone All of us are inclined to be self centered—childish, if you please—and think only about the immediate present until something hits us between the eyes Then we see how shortsighted we have been It is foolish to worry over the mistakes we have made, and we have all made some The wise person profits by mistakes Even a little child quickly learns not to touch hot objects. Some of us, however, are more intelligent than others

and not only learn quickly from our own mistakes but may even profit from a knowledge of the mistakes of other people. However, a considerable number of us seem to have to learn from more or less bitter personal experience Then we are like the members of the family who, when the circus came to town, discovered that they had no money to buy tickets What could they do? They just *had* to go to the circus, and so they sold the kitchen stove! When supper time came they realized that they had no means of cooking their meal It is the role of intelligent foresight to attempt to visualize the probable results of different lines of conduct and make wise choices.

PART ONE

FUNDAMENTAL CONCEPTS

1

OUR ENVIRONMENT

I SOCIAL FACTORS IN OUR ENVIRONMENT

Science and human welfare As short a time as fifty years ago there were no automobiles, moving pictures, radios, airplanes, nor, of course, such improvements in our living conditions as air conditioning and many of our labor-saving devices Electric lighting was in its early beginnings People died, on the average, ten to fifteen years earlier than they do now It cannot be assumed, however, that the quality of life has kept pace with its lengthening Although deaths from tuberculosis have decreased within the last twenty years, more people are dying of heart disease and cancer Accidents account for an ever greater number of deaths Whereas science is making it possible for the earth to support an increasingly large population, it does not make clear to us whether or not it is worth while to bring more babies into the world

Certainly on the credit side of the changes which have been taking place in our environment is an important reduction in the hazards associated with most infectious diseases On the credit side too may be mentioned the achievements gained in the broad fields of research, public education, freedom of religious worship, social welfare, sanitation, methods of agriculture, the freer flow of trade, the manufacture in greater amounts of more various goods, and, in general, the efforts of private and governmental agencies toward improvements in living conditions The introduction of labor-saving machinery, although not an unmixed blessing, should also be placed on the credit side of our present environment, for the machine has perhaps made possible greater advances in the material standards of living of this and the nineteenth centuries than was effected in all the preceding centuries of human life

We cannot close our eyes however, to the fact that there is another side to the picture Poverty is still with us much as preceding generations had it, and poverty breeds a vicious circle—ignorance, shiftlessness, and disease, which, in their turn breed more poverty The machine has released energy for the pleasures of living, but it has also, in large measure, supplanted such pleasures This fact has been productive of problems which did not exist in a handicraft age Production of goods of a kind and on a scale formerly not dreamed of has been made possible but the necessity for adaptation to new kinds of working conditions has caused a stress which has had noticeable effects upon the health of individuals and communities

Let us mention a few of these changes One of the most important is *technological unemployment*, by which is meant the displacement of men by labor saving machinery Many of these men remain permanently out of work, and although others are able to learn new skills and get jobs in other fields of industry, the worry and strain consequent to their loss of employment is frequently a cause of mental and physical ill health There are also new kinds of occupational diseases such as silicosis and lead and radium poisoning that are the direct result of modern industrial conditions There is the monotony of many jobs in the mass production industries which dulls the minds and strains the nerves and muscles of the workers There are industrial accidents There is the speed up of the assembly line There is the problem of the use of increased leisure time that comes with the shortening of the work day In short there is a whole new train of health problems that our generation is facing with, as yet, no satisfactory solution

There is plenty of sunlight for all who live in temperate or tropical regions but not all these inhabitants can get as much sunshine as they need to be healthy Is there anything freer than air? And yet many persons have to live in quarters where the air is anything but wholesome There is plenty of water for everyone But in many communities it is practically impossible, at times to

obtain safe public drinking water And soil! What can be commoner? There is abundance of it for pastures and for the raising of crops and yet millions of the population of the United States are undernourished if a recent federal government report is trustworthy and partly, it would seem, because they cannot afford to pay for the right kinds of food, nor for a sufficient amount

The conclusion to be drawn is that something besides the advancement of science is necessary, if human progress is to be realized The question as to what we are going to do about the findings of science is as significant as the findings themselves Science gives us the means of making over our environment, within certain limits but it does not insure that living will be better than it has been Sometimes it is worse, but let us here be careful in our thinking It is human ignorance and selfishness, not science, which makes living worse Science must be supplemented with education and the acceptance in our daily lives of socially desirable aims and ideals These aims and ideals must also characterize the conduct of governing bodies, whether local, state, or national if progress not retrogression, is to follow in the wake of scientific discovery Although scientific investigation and research are in their infancy, society is far from making the best use of the already well established findings

We shall have many opportunities in this book to discuss the wonderful achievements of science We might, therefore, come to a wrong conclusion as to the degree of progress man has made in conquering the forces of nature Man does not conquer nature, rather his progress depends upon learning how to make use of natural forces His strength and knowledge are too puny to conquer or control nature except in very minor ways Hence, it will always be necessary to view with modesty the many remarkable inventions and techniques that man has evolved Applications of scientific knowledge should always be guided by a philosophy that is characterized by social insight and good will, if well being is to be the result of scientific accomplishment

Institutions, laws, and customs as parts of the environment This discussion of the social factors in our environment would be markedly incomplete if we failed to take into consideration the varying effects upon health and general welfare of institutions, laws, and customs. When we use the word institution we have in mind such factors in our environment as the family, church and educational and corrective agencies of various types. Our institutions, laws, and customs have been built up through long periods of time and as a result of many kinds of human experience They are far from being perfect in the sense that they always minister in the most desirable ways to human needs and desires, but they constitute the accepted formulation of what society has come to consider important means for meeting social needs.

We cannot do just as we please Every one of us has to learn to make reasonably acceptable adjustments to social demands. We sometimes call this the socialization process. It always requires years of education and some of us are slow to learn Probably none of us grows up in every respect. We all tend to cling to certain childish habits. We may never get over fear of the dark, or we may continue to demand consideration in some of the ways in which we received special care as children. The most unfortunate ones are those who remain upon a childish level in respect to traits which are so handicapping that they are constantly getting into trouble with their fellows. Some of these individuals society places behind bars in order that the rest of us may enjoy a greater degree of safety

Institutions, laws and customs are not static but often they change very slowly in meeting new or modified human needs as these appear In primitive societies they are rigid and change only through long periods of time In a society such as ours, where many physical features of our environment are undergoing rapid changes, it is highly desirable that they should possess considerable flexibility in order that material conditions may be met most intelligently The great aims of education are sometimes expressed in the following terms first, to conserve what is worth

sible, by analysis, to divide it into factors which may be designated as social and physical. Many of these factors are so interrelated that the distinctions between them are arbitrary and are made for the sake of convenience in studying them. In the second part of this chapter we shall discuss several basic factors as they affect our physical environment—the nature of sunlight, the atmosphere, climate, water, and the crust of the earth. We shall study these factors, not primarily as they are viewed by the student of pure science, but rather in certain of their applied aspects. In other words, we are especially interested in the possible relationships they may have to our health and well being which, by their very nature, have social significance. Thus, our subject might perhaps be called the physico biological, or the physicosocial, aspects of the environment.

For example, man has learned how to produce artificial sunlight and condition the air in the buildings he constructs. He is able to purify water and has learned how to use this medium in various ways in industrial processes. He is constantly finding new ways of conserving and enriching the soil, and the various ways are too numerous to mention in which he makes use of the earth's crust as a source of material in the construction of buildings, in machinery, in road building, in engineering projects and in the fields of agriculture, communication, and transportation. Thus man's cultural world and the physical conditions of the universe around him are inextricably interrelated.

II PHYSICAL FACTORS IN OUR ENVIRONMENT

The earth's adaptation for life. Has it ever occurred to you to marvel at the existence of life upon the earth? Do you realize that this little planet we call the earth is perhaps the only place in the vast universe where are found the conjuncture of conditions of light, temperature, atmosphere, water, and soil that permit life as we know it to evolve and continue to exist? It is true that other stars besides our sun may have planets upon whose

surfaces conditions similar to those found upon the earth may exist, and if so, then life may be present upon them However, other stars are so far away from us that it is impossible, even with the most powerful telescopes, to see any planets which may revolve around them

The astronomical bodies which are nearest the earth are the planets Venus and Mars and the earth's satellite, the moon They receive light and heat from the sun in amounts most nearly like those which the earth receives, and therefore one might suppose that they also may support life However, Venus is one-third nearer the sun than the earth, and therefore must be much warmer than our planet, and Mars is about half as far away again from the sun as the earth and has a surface temperature known to be much colder than ours The other planets in the solar system are either too far away from the sun or too close to it to receive the proper amounts of heat and light to support life

How about the moon? It is at approximately the same distance from the sun as we are and we might therefore assume it to be a congenial place for living things However, this is not the case There are other factors besides the distance from the sun which adapt the earth to the needs of living things A period of the earth s rotation on its axis is one of these factors A day of twenty four hours duration helps to assure a suitable range of temperature to permit water to remain in a liquid form upon its surface, another of life s necessities The moon s day is about twenty eight times as long as ours, and this results in great extremes of temperature There is no evidence of water upon the moon Mars, on the other hand, has a day of about the same length as ours The period of Venus' rotation is not known because its surface is constantly covered by dense clouds

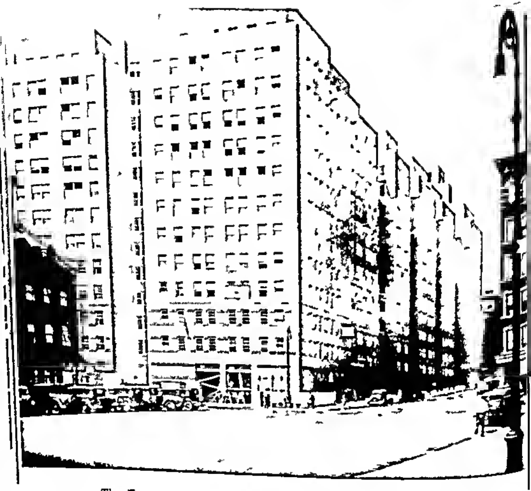
The atmosphere of the earth is unique Life, as we know it, requires an atmosphere containing oxygen and carbon dioxide within certain limits of density There is no atmosphere upon the moon, and Mars s atmosphere is exceedingly thin compared with ours It is quite likely that Venus has an atmosphere more

like our own, but it appears to be exceedingly hot and humid

Finally, the composition of the soil and the presence of large bodies of water upon its surface are important factors in helping to make our earth a fit habitat for plants and animals Just how the first bit of life appeared upon the earth will probably always remain a mystery. The fact, however, remains that as we view the earth today it constitutes the best of all known places for living things. Let us examine a little more definitely the nature of these physical factors that constitute the essential conditions necessary for life.

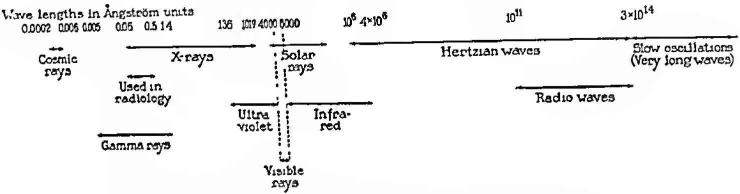
Sunlight. Sunlight, it may be said, is not directly necessary for human life a human being may live in darkness. However, he cannot live very long, if he does not have access to foods which fundamentally depend for their manufacture upon the presence of sunlight This is because all of our food supply, except water and mineral matter, is dependent either directly or indirectly upon the fact that there are certain activities taking place in green plants which can occur only in the presence of light. Human life and all other animal life, as well as plant life, could not exist were it not for one substance, *chlorophyl* This is the name given to the green coloring matter of plants, which carries on a certain type of activity known as *photosynthesis*, or the manufacture of foods by green plants in the presence of light

Food-making is a synthetic process, the first part of which consists in bringing about a union between carbon, which is extracted from carbon dioxide present in the air, and water that is taken up by plant roots from the soil, which passes through them, through the stems, and out to the green leaves where most of the food-making is carried on In the presence of light the chlorophyl in the leaves causes the carbon and water to unite in a certain proportion and sugar is made This sugar is used as one of the basic substances for the later manufacture by the plant of other types of foods. If the sun's rays should no longer reach the earth, photosynthesis would cease and living things would soon die.



The East Side transformed *(Underwood & Underwood)*

CHART SHOWING THE VARIETIES OF RADIANT ENERGY



An examination of this chart reveals certain facts about the different forms of electromagnetic energy, among which are the following (1) the waves used in radio are among the longest, (2) the solar rays occupy a middle position and contain the rays of visible light and some of the infra red and ultra violet rays, (3) the gamma rays and the X rays overlap and some of them are used in taking X ray photographs, (4) the cosmic rays are the shortest rays known (An Ångstrom unit equals one ten-millionth of a millimeter The wave-lengths of visible light expressed in inches range between .00003 and .000015 inches)

in radio These are next in length to the waves used by most broadcasting stations Going along the scale from long to short waves we come next to the waves which give us the sensation of heat The shortest of these, known as the infra red rays, merge into the part of the scale called visible light Next to the visible light waves are the ultra violet rays, and still farther along the scale we come to X rays, gamma rays, and finally cosmic rays In recent years physicists have added greatly to our knowledge of the nature of radiant energy, although our bodies are sensitive to only a small percentage of the different forms it assumes

Some of the known effects of radiant energy From the point of view of our health the ultra violet and infra red rays of sunlight and some of the X rays and gamma rays appear to be the most important When ultra violet rays strike the surface of the body, they change a substance that is present in the skin and known as *ergosterol* into vitamin D, which is necessary for the proper development of the skeleton If vitamin D is lacking and not furnished in sufficient amounts to young children, a condition called *rickets* appears that is characterized, in part, by a faulty development of the bones Vitamin D is present in certain foods notably fish oils and egg yolk In those parts of the earth where the sun s rays are weakest, that is where they fall in a very slanting manner upon the earth s surface, it is especially necessary to secure foods rich in vitamin D Rickets is rarely seen in the tropics because in those parts of the world there is an abundance of bright sunlight

It is a well known fact that it is easily possible to expose the body to too much sunlight and that it is necessary gradually to accustom the skin to such exposure until it has developed a coat of tan which interferes with the penetrating power of the ultraviolet rays Races accustomed to living in the tropics develop dark pigment cells in the skin which are effective in giving them protection Sun lamps, that are now on the market, may cause serious injury to the skin if not properly used They should be employed only under a physician's supervision

The infra-red rays are the heat giving rays In some types of cases lamps producing them are used by physicians to relieve pain Because heat is relaxing they have a beneficial effect upon taut muscles

X rays and gamma rays are used extensively in medical practice They have become the physician's most valuable aid in diagnosis They also have curative value in the treatment of certain forms of cancer

X-rays have the power of passing through apparently solid objects, but the denser the substance the less is their power of penetration Because of this characteristic and because they affect photographic plates or films in the same manner as light rays, they are used in making shadow pictures of various parts of the body In these pictures the bony parts of the skeleton show more clearly than the fleshy parts because of their greater density X-ray pictures are invaluable to the physician in setting fractured bones or in detecting the position of foreign substances, such as needles, which may have entered the body X ray photographs of the teeth are also frequently made to determine whether there are root abscesses. And X-ray pictures assist in diagnosing many other types of bodily disorders.

Although we cannot feel X-rays, they affect body tissues and, if used in too large amounts, irritate them more or less severely The fact that such rays have a selective effect upon certain types of tissues makes it possible to use them advantageously in treating some cancerous growths. X rays are especially harmful to tissues that are undergoing cell division, that is, tissues which are growing rapidly Since cancers consist of cells exhibiting this characteristic, if they are not too deep-seated and if the growth has not proceeded too far, they may be completely eradicated by the use of X-rays. The organs making germ cells, the testes and the ovaries, are also largely composed of cells undergoing rapid cell division, and therefore it is possible to produce sterility by subjecting them to X-rays

sential for life Oxygen is used by all living things, and carbon dioxide is one of the raw materials used by green plants in photosynthesis. The nitrogen of the air cannot be used directly by most living things The only exceptions are the *nitrogen fixing bacteria* which live in the roots of leguminous plants They take nitrogen out of the air in the soil and make it usable by green plants in the manufacture of protein

Oxygen unites readily with several other elements This process, which is known as *oxidation*, is one of the most common occurring in nature Oxidation may be either rapid or slow In the former type it is called combustion, or burning, and is characterized by the production of both heat and light In slow oxidation, examples of which are decay and rust, there is no light, but heat is given off although at a slower rate than in rapid oxidation and often in an amount which we cannot feel Slow oxidation is constantly going on in living things. In fact, this is the source of the energy which is evidenced in all their varied forms of life processes and activities. The heat liberated in our bodies and in other living things as the result of the oxidation of foods is produced in a manner fundamentally similar to that which occurs when coal or other fuel burns.

The process of oxidation, in addition to being always accompanied by heat, results in the production of a new substance The new substance is called an *oxide*, which is a combination of oxygen with some other element There are oxides of iron, sulphur, hydrogen, magnesium, and certain other elements The most common of these is carbon dioxide which is constantly being made in the tissues of living things as a result of the oxidation of foods containing carbon.

The composition of the air varies with its altitude In the lower atmospheric levels, that is, in the air around us, oxygen composes about one-fifth of its total volume, nitrogen most of the other four fifths and carbon dioxide about four hundredths of 1 per cent. There is also always present in the air a certain amount of moisture in the form of water vapor which may be condensed

arctic regions there are not such marked changes, the weather is warm the year round in the former regions and cold in the latter Weather, climate, and seasons exert marked effects upon our health and well-being

The seasons are caused principally by the fact that the earth's axis with reference to the plane of its orbit is tilted at an angle of 23½°. If it were perpendicular to the plane of its orbit there would be no seasons, but the weather would be about the same throughout the year at any particular place Furthermore, the earth's axis remains pointed, so to speak, at a particular spot in the heavens throughout the year These phenomena result in making it appear to us that the sun changes its position in the heavens, in the summer being more directly overhead than in the winter The sun seems to cross the equator twice each year—once in the spring and again in the fall Naturally the periods in which the sun is more nearly directly over our heads at noon are warmer than when its rays fall more slantingly upon our part of the earth

Climate constitutes an important factor in determining whether a place is suitable for living things There are regions on the earth's surface which are either too cold or too hot for human habitation The temperate zones of the earth are, generally speaking, the best places for men to live because of their comparatively mild climates Those zones of the earth's surface which are characterized by what are called cyclonic storms are the places where the most advanced civilizations have developed There is something stimulating to the mental and physical processes of the body in a zone where there are marked temperature changes People living in tropical regions are not, as a rule, as vigorous as those living in milder climates Probably this is not entirely due to the climate, but in large measure to the fact that in most tropical regions the products of the soil are more easily obtained and man's needs in the way of clothing and shelter are more easily met In other words, some of the incentives to work are at a low level in many tropical countries

In addition to the temperature of the air, another important

factor relating to human welfare is that of *humidity*, by which is meant the amount of water vapor present in the air We all know the effect upon our feelings and disposition to work or play, which this factor produces The hot, humid "dog days" of summer seem at times almost unbearable, and we have all experienced a feeling of relief when such a "spell of weather' is broken We can stand the heat much better in regions where the humidity is low

In general, it may be said that weather is a matter of geographical location, and is determined largely by three factors—latitude, the distance from large bodies of water, and elevation above sea-level The influence of latitude and of elevation are too well known to need any explanation here Large bodies of water greatly influence the climate of neighboring regions because of the fact that water absorbs heat more slowly and also gives it off more slowly than land Thus the climate of coastal regions is not marked by the extremes of temperature that are found in places of the same latitude that are far removed from the moderating influences of oceans or great inland seas However, coastal regions have, as a rule, greater humidity than mid continental areas

What are some of the more common effects that atmospheric conditions have upon our health? Some diseases, such as syphilis and septic sore throat, are not influenced by the seasons On the other hand, colds and pneumonia are examples of diseases which are more prevalent in the fall, winter, and early spring than in the summer Digestive disturbances increase in the summer months, owing in part, at least, to the fact that foods are more apt to spoil in warm weather than in the cold months Babies especially are apt to have diarrhea in the summer In many instances this is because milk deteriorates rapidly unless its temperature is kept close to freezing Another disease which is even more definitely limited to certain seasons is hay fever

Certain diseases are ***endemic*** in tropical or semi tropical regions, that is, they occur continuously in those places Among these are African sleeping sickness and certain tropical fevers, such as yel-

low fever Hookworm disease can only exist where the climate is such as to make it possible for hookworms to live in the soil and for this reason it is found only in warm climates, such as our southern states.

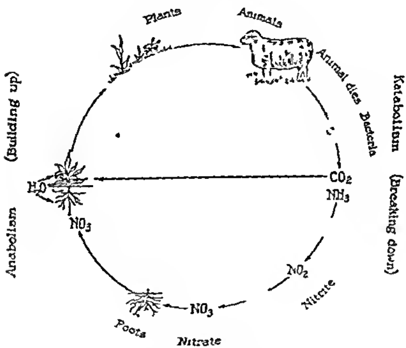
Water Primitive man could only occupy regions where there was easy access to drinking water Hence his first more or less permanent habitations were along the banks of streams In later stages of civilization he constructed aqueducts to convey water to him from distant places He learned how to use water in carrying off community wastes by means of sewers Still later he devised means of irrigating certain regions and building dams to regulate the flow of streams and to supply power for the generation of electricity On the other hand he has also learned how to drain swamps and thus reclaim lands that otherwise could not be used By this means regions have been made healthful which previously were uninhabitable The swamps constitute breeding places for mosquitoes which are responsible for spreading malaria Thus, by draining the swamps in the Panama Canal Zone, it became possible to build the canal without an attendant great loss of life from this disease

The places where human beings can live on the earth healthfully and in considerable numbers constitute only a small percentage of the earth s total surface and are largely determined by conditions of rainfall and water supply More than two-thirds of the earth s surface is covered by water This large proportion of water to land is a necessary factor in the production of adequate rainfall Only about one-quarter of the land areas is suitable for man s habitation so that actually only approximately 8 per cent of the earth s surface constitutes really good living conditions for mankind Great deserts mountainous and rocky regions, very cold zones and dense jungles occupy considerable areas Coastal plains and river basins are the choice places for human habitation and of these many are not desirable because of harsh climates

As we mentioned previously, oceans have a marked effect upon climates of many regions. This effect is partly because of the

kinds are the bacteria which hasten decay and are therefore spoken of as the *bacteria of decay* If it were not for them, our earth would become an uninhabitable place They produce chemical changes in dead and decaying material that result in making it usable by plants in the manufacture of proteins

Nitrogen cycle



Interesting experiments in the growing of plants for food without soil are being conducted today This is called "tray agriculture" However, while in these experiments the plants are grown in water in trays and their roots are not actually anchored in soil, the sources of their nourishment are the constituents of the soil which are furnished them through fertilizers placed in the water Problems connected with soil conservation and enrichment are of

vital importance to our welfare, and many experiments and much valuable work is being accomplished along these lines

Summary of man's physical environment The history of the development of civilization may be viewed in large part as a continual series of adjustments of man to natural conditions To some extent he has been able to modify them and improve them, but always for his basic needs—air, food, water, and materials for shelter and clothing—he has had no sources of supply other than the raw materials the earth has furnished him

Spatially the human environment is limited to the bottom layer of a gaseous envelope which covers the earth and which we call the atmosphere Man has been able to burrow a short distance into the earth—a mile or two—but what is that by comparison with the earth s diameter of about 8,000 miles[2] He has learned how to penetrate a short distance below the surface of the ocean and to ascend a few thousand feet into the atmosphere But these distances are very small when compared with ocean depths and atmospheric heights The total range of man s activities in a vertical direction is something like ten miles which is perhaps 5 per cent of the thickness of the atmosphere When these distances are compared with the depths of space into which our great telescopes enable us to peer, man s sphere of activities dwindles into insignificance

Viewed in relation to the immensity of the universe and the infinitude of time, any individual human being is seen as a tiny speck of matter that exists momentarily upon the surface of an insignificant astronomical body, called the earth, which, with eight other known planets, revolves around a central body, the sun The sun is a medium sized star which is one of billions of stars that help to make up the universe and which are separated from each other by inconceivably great distances

Nevertheless, from another point of view, the human organism takes on the dimensions of a gigantic system of matter Whereas the telescope shows us a universe of inconceivable distances, the microscope and other instruments for examining minute forms

disclose a universe of the opposite type, of which the fundamental units or 'building blocks" are so tiny as to baffle our imagination These infinitesimally small units, called protons and electrons, are believed to make up atoms and molecules which scientists tell us constitute matter Compared with one of these units the human body assumes gigantic proportions

The size of the human body, however, is a relatively unimportant matter Man has one characteristic which places him in a unique position in the universe He possesses *intelligence,* which is the ability to learn from experience and modify behavior as a result of the knowledge thus gained So far as we know, no other organized mass of material has developed the ability to think and feel and plan and remake the world to anything like the extent we find in man The knowledge that each of us possesses characteristics which place him far above any other known form of life should bring with it feelings of awe and responsibility as well as profound satisfaction

II

OUR BODIES

1. TWO THEORIES REGARDING THE NATURE OF LIFE

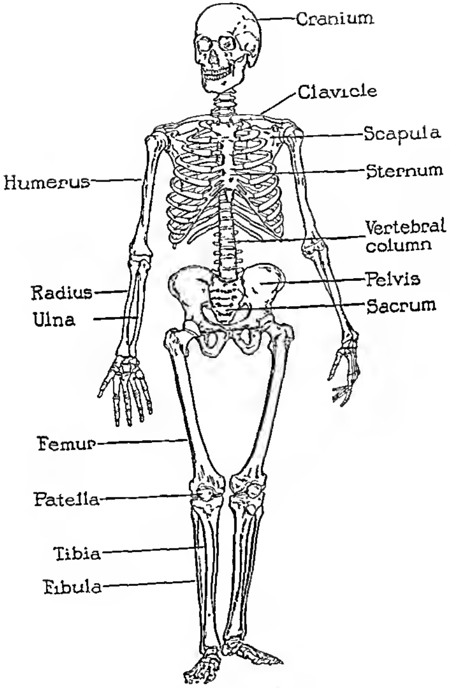
Vitalism and mechanism Ever since the beginning of recorded history men have tried to solve the problem as to what life really is Many views have been expressed, and these may be summarized under two heads The older conception, *vitalism*, is that life is basically a mysterious supernatural, vital force which is beyond human understanding The newer conception, known as *mechanism*, admits that there are and probably always will be unknown elements in the study of living things, but it points to the fact that science has already furnished answers to many biological questions about the nature of life that were previously considered unanswerable It holds out the hope that, if we continue to make investigations still more questions concerning the nature of living things will be answered This implies that we make a fundamental assumption, namely, that by means of scientific research life activities will be better understood The latter attitude is the one taken by the majority of biologists today, although many are frank to confess that, in their opinion, it is quite likely that science will never be able to answer all the questions

Let us see some of the reasons why biologists, as a group, favor a mechanistic conception of life rather than a vitalistic one In the first place, science has been able to unravel many of the so-called mysteries of life For example, recent scientific research has demonstrated that certain substances can be manufactured in chemical laboratories which it was formerly believed could only be produced by living organisms The first of these substances was urea, manufactured about one hundred years ago, but since that time many others have been produced

The discus thrower—a representation not only of physical beauty but of poise and strength Sculpture by Myron of Athens fl c 450 B C (*Ewing Galloway*)

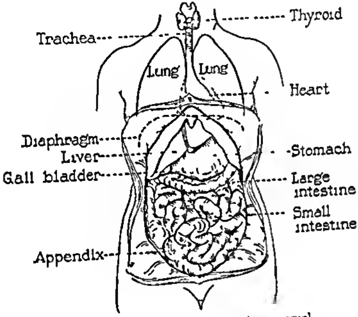
From busts in the American Museum of Natural History New York showing prehistoric types of men Pithecanthropus erectus Piltdown man Neanderthal man and Cro magnon man

American Museum of Natural History



The human skeleton.

Most of the space in the abdominal cavity is occupied by the intestines which are coiled about in what appears to be a haphazard manner, but in reality its different parts are held in definite relationship to each other by a supporting membrane, the *peritoneum* Connected with the intestines is the heaviest organ of the



Surface view of the organs in the human trunk

body, the *liver*, which is situated directly under the diaphragm Another organ, the *pancreas*, located in back of the stomach, is also connected with the intestines Both the liver and the pancreas secrete important juices which are poured through tubes into the intestines near their junction with the stomach The juice from the liver is the *bile*, some of which is stored for a time in the *gall bladder* This juice enters the intestine through the *bile duct* There are other organs in the abdominal cavity, among which are the *kidneys*, one on each side in the small of the back, the *urinary*

bladder, and parts of the reproductive organs, which are located in the lower part of the cavity

The parts of the female reproductive organs within the abdominal cavity consist of the *ovaries*, the organs which produce egg cells, or *ova*, the *Fallopian tubes*, through which the egg cells move, the *uterus*, or womb, in which the young develop before birth, and the *vagina*, or birth canal In the adult male the main parts of the reproductive organs consist of tubes which serve to convey the *spermatozoa*, or male generative cells, from the *testes* in which they are manufactured, to the exterior of the body

Extending from the heart to all parts of the body is a system of tubes called the *blood vessels*, which vary in diameter from nearly half an inch for the largest to those which are microscopic Blood flows through them in a continuous circulation which never ceases during life There is another system of tubes which also reaches into every part of the body and which also varies in size from those that can easily be seen by the naked eye to those that are microscopic They are the *lymphatic vessels* and are connected with the heart indirectly by being joined to one of the blood vessels near it The fluid flowing through them is called *lymph* The lymph consists of that part of the blood which has seeped out through the walls of the microscopic blood vessels together with certain waste materials that enter the blood from the parts of the body through which it flows It bathes all parts of the body, slowly collects in the microscopic lymphatic vessels, and then flows through the other parts of the lymphatic system back into the blood The blood and lymph are the media for furnishing all parts of the body with oxygen and nourishment and for carrying the waste materials away from them

This brief survey of the macroscopic appearance of the body would be incomplete if no mention were made of the *glands*, structures that produce substances which are either useful to the body or are given off as waste Glands are of two types secretory and excretory A *secretion* is a substance which serves some useful purpose in the body whereas an *excretion* is a waste product

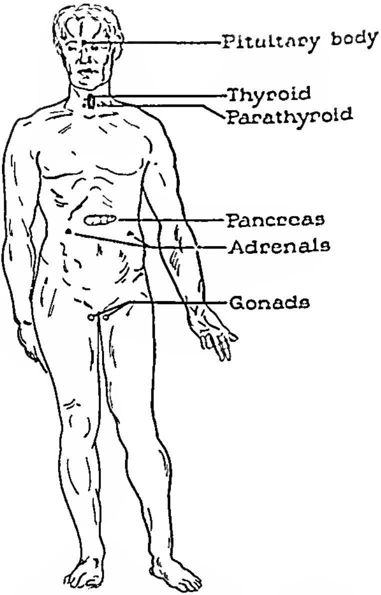
Thus the saliva and the oil manufactured by certain glands in the skin are examples of secretions, the urine is an excretion produced by the kidneys

Secretions are of two types external and internal By an *external secretion* is meant one which is either poured out upon the surface of the body or into one of its several cavities where it performs some useful function Thus, the *gastric juice*, or stomach juice, and the saliva are both examples of external secretions. This may be confusing since these juices are not poured out upon the surface of the body and might therefore be thought of as internal As a matter of fact, all of the digestive juices are classified as external secretions

The term, *internal secretion*, is applied only to substances which are absorbed directly by the blood stream As they are carried around the body by the blood they produce profound effects upon various parts They accomplish their work by means of certain activating substances called *hormones*, or *endocrines*, which, though produced in exceedingly small amounts, are of great significance to various types of bodily functioning Glands producing internal secretions are known as *endocrine glands* and are found at the base of the brain in the front of the neck, in the pancreas, on top of the kidneys, in the ovaries and testes, and other places.

We are all familiar, whether we have studied human physiology and anatomy or not, with the external appearance of our bodies We know the nature of the parts called skin, hair, nails, tongue, nose, eyes, etc The internal organs, however, to which we have been calling attention are located in places where they cannot be seen, and do their work during health in a manner that does not ordinarily make us conscious of their existence Hence, they are apt to be more or less ignored in our thinking Our level of efficiency, however, is largely dependent upon their harmonious functioning Our study should help us to understand this.

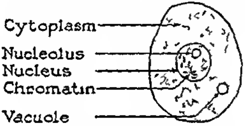
Cells, the units of plant and animal structures When plant or animal structures are viewed under the microscope we find that



Location of some of the glands producing hormones or internal secretions

they are composed of one or more units called *cells* If they consist of a single cell, they are spoken of as being *uni cellular*, if they consist of more than one cell, they are called *multi cellular* The animals and plants with which we are most familiar belong to the latter group Our own bodies consist of countless numbers of cells

Although generally cells are somewhat spherical, they assume many different shapes They are also of various sizes, although



A typical cell

the great majority are too small to be seen except with the help of a microscope Some cells have projections of living matter extending from them that occasionally reach several feet in length This is the case, for example, with certain nerve cells, whose prolongations frequently form bundles of fibers something like a cable There is a whole field of science called *histology* which is the study of the appearance of cells as seen under the microscope Students of histology acquire the ability to recognize the different kinds of cells by means of the many ingenious methods that have been devised for making microscopic preparations of plant and animal tissues, and especially by using various kinds of stains

Although cells are different in regard to size and appearance, they are alike in containing protoplasm, which is gelatinous in its nature A certain part of the protoplasm of a cell is usually denser than the rest and when the cell is stained it stands out prominently This is the *nucleus* Usually the nucleus is near the center and is completely surrounded by a more fluid material known as

each other but are closely interrelated as is evidenced, for example, by the fact that in accident or disease when one or two of the systems may be primarily affected, other systems are also apt to become involved

III DEVELOPMENT OF THE BODY

Prenatal development of a human being Human life starts as a *fertilized* egg cell, that is, one with which a sperm cell has united This cell shortly divides into two cells and later each of these into two others, these four into eight cells, the eight into sixteen and so on This cellular division proceeds rapidly and from these early cells originate the multitude of cells which later compose our bodies At first the cytoplasm of these cells looks very much alike, but as time passes the cells become differentiated in appearance and function and form themselves into groups which eventually evolve into the tissues and organs of the body

The *gestation period*, or the period before birth, averages about nine months During the first six or eight weeks the young organism is spoken of as an *embryo* and later it is commonly called a *fetus* In early prenatal development the human embryo passes through a remarkable series of changes in each of which it resembles, in certain respects, lower forms of life These characteristics normally disappear before birth although occasionally a baby is born with a rudimentary tail or with marks upon the side of the neck where the gill slits existed in the embryo The early prenatal development of a human organism is strikingly similar to the embryonic development not only of other mammals but of birds, fishes, and reptiles Biologists interpret these facts as indicative of a kinship with lower forms of life However, the human embryo is never at any time a worm a fish, a tadpole, a monkey or anything but human

During gestation, as well as later, the organism requires oxygen and nourishment These substances are furnished to its cells by means of its own circulatory system The fetus, however, must

obtain its oxygen and nourishment from the mother's blood, although the blood streams of the two organisms do not actually mix with each other The maternal blood comes very close to the blood of the fetus, only thin membranes separating the two streams Through these membranes *osmosis*, the passage of a gas or liquid through a membrane, occurs, that is, oxygen and dissolved food substances pass through them from the blood of the mother, and carbon dioxide and other wastes pass out through them to the maternal blood from the fetus This means that the mother's lungs, circulatory system, and digestive and excretory organs have an extra amount of work during pregnancy

There are many superstitions connected with pregnancy A very common one is that certain types of experiences involving a nervous shock to a pregnant woman may result in marking the fetus in various ways There is no scientific evidence to support such a belief, inasmuch as there is no connection between the nervous system of the woman and the unborn child Any change in the composition of the expectant mother's blood resulting from an unpleasant experience might temporarily affect the blood of the fetus, but there is no known way that it could mark the unborn child Birthmarks are due to an abnormal pigmentation of the skin

Another common superstition connected with pregnancy is that the interests and abilities of children may be influenced by special activities to which their mothers have devoted their attention shortly before their birth It is, of course, desirable for all of us to avoid shocking experiences and to make wise use of time, and it is especially important that the pregnant woman's activities be safeguarded and wisely directed, but primarily and largely for her own health rather than because of any effect it may have upon the unborn child

Postnatal development At birth the infant's environment undergoes a radical change It suddenly becomes a separate human being and henceforth has a physical life of its own. The infant uses its lungs for the first time Food is taken directly into its

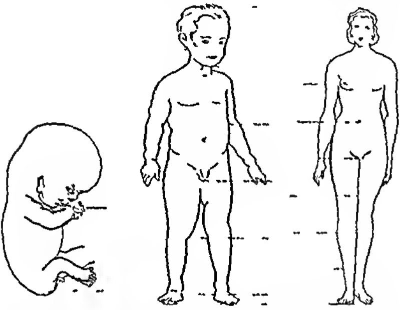
digestive organs, and its organs of excretion begin to function Furthermore, its surroundings have greatly changed No longer is it so carefully protected against changes of temperature and injuries It is not to be wondered at that the first few weeks and months of life are the most hazardous, and result in higher mortality than during any other period of corresponding length

Growth and changes in appearance of the human body proceed most rapidly before birth, as is plainly evident when one considers that in the short period of nine months a microscopic cell develops into a human baby After birth the body grows and changes at a much slower rate than during its uterine development, although its progress during the first year after birth is much more rapid than in any subsequent year of life The normal rate of growth gradually diminishes, except for a spurt during a few years at the time of puberty and early adolescence, until physiological maturity is reached in the early or middle twenties when growth ceases The rate of growth differs in boys and girls Girls develop faster up to the age of adolescence, which appears earlier in them than in boys At about the college age, however, boys, as a group, have outstripped the girls in weight, height and strength

Another interesting fact is that not all parts of the body develop at the same rate A true metamorphosis occurs after birth as well as before By way of illustration, consider that at birth the head is about as broad as the shoulders If the head and trunk developed proportionally at the same rate of speed in later years the individual would be a monstrosity There is another striking change in the relative lengths of the arms and legs as compared with the length of the trunk At birth they are relatively much shorter than they afterwards become

Human development from the phylogenetic point of view Reference has already been made to certain anatomical changes occurring during prenatal development, which generally have been interpreted by scientists as indicative of our kinship with other forms of life Biologists, as we shall see later, classify man

as a *primate*, in which group are also included monkeys, apes, gorillas, chimpanzees, and orangutans It is believed that all these forms had a common ancestor but that their evolutionary descent —or ascent—from their ancestor has followed different courses.



Comparison of bodily proportions of a child with an adult From left to right fetus, eight-and-a half weeks (*after* His), proportions of a child, "five heads, proportions of an adult eight heads"

This belief definitely contradicts the idea that is still current that "man descended from a monkey"

Prenatal characteristics constitute only one of several types of evidence which support the theory of human evolution Perhaps, if we could go back far enough in the history of the earth, it might be possible to show that all the many forms of animals living today have descended from some simple, one-celled organism It is unlikely, however, that just what happened hundreds of millions of years ago, when it is believed that life first began to make its appearance upon the earth, will ever positively be known

There are, nevertheless, certain very definite observations regarding the nature of man's body, and of the bodies of other animals, that are illuminating from the point of view we are here considering Let us note a few of these

Common characteristics of protoplasm In the preceding chapter it was pointed out that all living things have common needs, such as oxygen water, food, and certain temperature conditions This fact might lead us to believe that basically they are made of the same kind of stuff, and biologists tell us that this is true Protoplasm has certain characteristics in common, whether it is in the cells of plants or animals This fact would point to a kinship among all living things—not just among plants as such and animals as such It would seem quite likely that both plants and animals have a common ancestor There is substantiating evidence for this idea also in the fact that certain forms, such as bacteria and some other single celled organisms, have more or less arbitrarily to be designated as either plants or animals, inasmuch as they are like plants in some respects, and in others like animals

Although there are minor differences in the protoplasm of different forms it is alike in being composed of certain elements combined in such a way as to form protein compounds These exist in what is called a *colloidal* state, that is, in a state which in everyday language may be described as jelly-like, or gelatinous *Colloids* are composed of units of structure which cohere very firmly, making particles larger than single molecules, and which are too large to pass through organic membranes like the walls of blood vessels It is the colloidal property of protoplasm which permits the cell activity that makes life possible The elements that are always found in protoplasm are carbon, hydrogen, oxygen, and nitrogen In addition, sulphur, iron, phosphorus, and certain other elements are frequently present In all, at least eighteen elements are found in the protoplasm making up the human body

Vestigial structures in the human body Vestigial structures are rudimentary or degenerate parts which at present serve no useful purpose, but which, it is believed, were at one time of use to

man's ancestors Thus, in man, although it is normal for the tail to disappear during embryonic development, there remain a few small bones at the base of the spinal column called the *coccyx*, which is in reality a vestigial tail The appendix is another vestigial structure that is believed to correspond to a useful organ in the digestive systems of some animals, although in man it is of no known use, rather, it is a menace to health There are certain vestigial muscles in the human body which correspond to those in some other animals that make it possible for them to move their ears and to make their hair stand on end In all, there are several score of these structures in man's body The most reasonable explanation for their presence is that they constitute evidence of man's evolutionary development

Comparative anatomy and physiology Even more striking than most vestigial structures as an evidence of human kinship to other forms of animal life are the many anatomical and physiological similarities which exist between man and other *vertebrates*, or back boned animals, especially those nearest to his own level in the scale of development, such as the mammals When the skeletons of vertebrates are compared the general body plan is seen to be similar

In the mammals there is a striking resemblance in many parts of the skeleton, bone for bone Other systems of the bodies of mammals—the circulatory, digestive, excretory, and so forth—are also quite similar and the microscopic appearance of the different types of cells are of the same general pattern Chemical tests of the blood and other tissues exhibit correspondingly similar characteristics Another significant point is that certain monkeys and apes are the only forms of life, as far as is known, that are susceptible to some diseases that attack human beings, such as the common cold and infantile paralysis This fact shows conclusively that there are similarities existing between the chemical composition of the tissues of these animals and of man, for otherwise they would not constitute a congenial soil for the development of the microorganisms that cause these diseases

ing for food, the time came when a certain group took to the ground This change constituted one of the most significant that has ever occurred to a living thing, for it undoubtedly led to an erect posture As a result of such a radical change in the environment of these creatures, it became necessary to make experiments in ways of living, if they were not to fall prey to animals lower in the scale of life These experiments undoubtedly contributed to the development of their intelligence, since it became necessary for them to make adjustments to new conditions if they were to survive

A tendency to an erect posture, it would seem reasonable to assume, would be stimulated by the fact that they would thus be able to see farther and, as a result, be at an advantage in perceiving enemies. It is noteworthy that of the primates man is the only one that walks with an entirely erect posture. It is also definitely known from a study of fossil skeletons that the posture of a recent type of human being who lived only a few thousand years ago, the Neanderthal man, was characterized by a marked slouch

The development of the human hand The hand of man has developed differently from that of his nearest animal relatives The position of the thumb is different from that of other primates being opposite to the fingers, whereas in the other forms it is on the same side as the fingers Man is the only animal that has developed to any considerable extent the use of tools His efforts to manufacture tools were at first very crude He became increasingly skillful as a result of more and more experimentation The terms 'Stone Age," 'Bronze Age,' and 'Iron Age describe the types of materials he has successfully and successively used as tools With the type of thumb which he is believed to have possessed at first, he must have experienced great difficulties in the making of tools As a result of tool making and tool using it is believed that the human hand has developed its present flexible form Of course, of greater significance than the mere development of the flexible hand is the fact that while he was experimenting in ways which resulted in the development of the hand,

than by intelligence. We know that our bodies furnish us with a very incomplete idea of the nature of the world around us. There are sounds we cannot hear. There are colors we cannot see. Our bodies have developed their ability to supply us with information about the world as a result of untold centuries of interactions between the organisms from which man is descended and the objects or forces in the environment which have affected them for good or ill. Thus, it comes about that there are in reality two worlds: the practical, everyday world about which our unaided senses give us important information, and the world of the physicist, the nature of which man is just beginning to learn.

The human organism is in many respects a very crude affair, unequipped to give us anything more than superficial information about our world, and yet how valuable is that information! We have only to think how handicapped the blind and deaf are to realize the importance of possessing a bodily mechanism which furnishes us with the basic information that is necessary, if we are to be able to make the adjustments that are fundamental to our living.

II. MAN'S PLACE IN NATURE

The classification of man. Zoologists attempt to classify all animals in certain large groups called *phyla*. Phyla are divided into *classes*, classes into *orders*, orders into *families*, families into *genera*, genera into *species*, and species into *varieties*. The development of the methods and criteria used in attempting to classify all the myriad forms of animals has taken centuries of painstaking observation by thousands of specialists in *taxonomy*, as this branch of science is called. It might be mentioned parenthetically that similar work has been done in the field of botany. As an illustration of the methods used in taxonomic zoology, let us briefly observe how man himself is classified.

Man is in the phylum called *chordata*, the group of animals that have a flexible, rodlike structure, a primitive type of back

bone at some stage in their development, either during embryonic or adult life In addition, animals in this phylum are segmented, have a dorsal, hollow nervous system, with its anterior part appearing as a brain, and they possess gill slits at some period of their lives Fishes, frogs, reptiles, birds, and all the mammals are chordates Therefore simply to state that man belongs in this phylum merely ascribes to him some general characteristics which he shares with thousands of other known species

The phylum chordata is divided into sub-phyla, one of which is called *vertebrata* This sub-phylum contains the animals which have a bony vertebral column as distinguished from the other chordata in which this type of structure does not develop Man, of course belongs in this sub phylum

In classifying man as a vertebrate animal we are, however, far from having defined his characteristics in a satisfactory manner There are many other kinds of vertebrates Man belongs in the class of vertebrates called *mammals* This means, in the language of zoologists that he has a diaphragm and more or less hair on the surface of the body, and that the young are nourished by milk secreted by the mammary glands of the mother When man is placed in the class called mammalia, we have gone quite a little further in describing his characteristics and yet there are over ten thousand species of mammals It, therefore, becomes evident that to designate man as a mammal still leaves a great deal to be said

To describe man more precisely it is necessary to place him in a still smaller group known as the order of primates which, as we have previously stated includes monkeys gorillas, orangutans and apes as well as man Other orders among the mammals are the *carnivores*, or flesh eaters and *ungulates*, animals with hoofs Blood tests indicate a closer relationship among the members of the primates than exists between any of its representatives and the representatives of any other oeder of mammals such as the carnivores Also, the mammals are strikingly similar with regard

III

THE RISE OF PREVENTIVE MEDICINE

1 CONCEPTIONS REGARDING THE NATURE OF DISEASE

Superstitious ideas about health and disease The mysterious is often confused with the supernatural in man's thinking Primitive man stood in superstitious awe and dread of such natural phenomena as storms, disease, death, famines, earthquakes, volcanic activities, and floods He was very apt to ascribe such events to the wrath of the supernatural beings who, he supposed, could be made angry or pleased by different forms of human behavior This type of belief resulted in feelings of submission and helplessness, both before and after a calamitous event, whatever its nature If disease or death are visitations of divine Providence, it follows that they should be accepted as just punishment for sin Constant fear and dread accompany superstitions and under such conditions a very important part of life consists in attempting to please or placate the spirits

The fundamental idea that disease was devised to punish man for evil doing is still present in the minds of many people, especially with reference to the so called social, or venereal, diseases—syphilis and gonorrhea One who accepts this belief, if he is logical in his thinking, affirms that nothing should be done to fight these diseases because they have been visited upon man as punishment for sin That there is something wrong with the basic assumption underlying this idea is evident in view of the fact that a large percentage of persons suffering from the effects of syphilis and gonorrhea became victims through no disregard of sex-social standards, many were either born with one or the other

of these diseases, or they were acquired innocently Especially is this true of syphilis Leading authorities affirm that probably only about fifty per cent of the victims acquire it through illicit sexual relations.

Our newspapers occasionally bear witness that in some communities in the United States today the "witch doctor" is still with us. Court records show that, by some people, he is considered responsible for many crimes, even murder and arson. The 'witch doctor' or 'hex is a flagrant example of superstition, and exists, fortunately, only in so-called backward communities that are still in the clutch of ignorance and fear However, similar characteristics are not confined to a few places. There is ample testimony of their widespread prevalence in the United States, though in less flagrant form, in the prosperity of quack doctors and in the enormous sale of patent medicines. This situation can be accounted for by an astounding gullibility and lack of knowledge of the facts of health and disease on the part of a large proportion of the population of the country

Modern attitude toward disease The modern conception of disease is quite different from the supernatural notion we have been considering We now know that only natural causes bring about disease, and we know that to a great extent we can arrange our environment and order our lives so as to minimize the possibility of contracting most forms of disease. It would be difficult to overemphasize the significance of this change as a factor contributing to human welfare As a result of an immense amount of scientific research there has developed in recent years a certain optimism with reference to disease which has been expressed in the statement that public health is purchasable In other words, it has become evident that the majority of diseases can be successfully combated, if not always by curative treatment, at least in the majority of cases, by preventive measures which, after all, are much more desirable and fundamentally important procedures In the case of those diseases against which man has been able to make little if any progress, there is every reason to believe

hospitals This is a much safer procedure than to ring the door bell of the first doctor s office you may happen to see, unless, of course, the case is an absolute emergency

Hippocrates, the ' father of medicine " The Greek Hippocrates a physician of antiquity who has come to be known as the ' father of medicine," and who lived in the fifth century B C, is credited with having been the first great physician to assert that diseases have natural rather than supernatural causes The oath which doctors take today before becoming practicing physicians is known as the Hippocratic oath This oath is one of the most interesting of human documents, partly because of its antiquity, and partly because it was the first well formulated ethical code of any pro fession It has exerted a profound effect upon the practice of medicine, and we shall quote it for this reason

> I swear by Apollo, the physician (Healer), and Aescula pius, and Health (Hygeia), and All heal (Panaceia), and all the gods and goddesses, that according to my ability and judgment I will keep this oath and stipulation to reckon him who taught me this art equally dear to me as my parents, to share my substance with him and relieve his necessities if re quired, to regard his offspring as on the same footing with my own brothers, and to teach them this art if they should wish to learn it, without fee or stipulation and that by pre cept, lecture and every other mode of instruction I will im part a knowledge of the art to my own sons and to those of my teachers, and to disciples bound by stipulation and oath, according to the law of medicine but to none others
>
> I will follow that method of treatment which according to my ability and judgment I consider for the benefit of my patients and abstain from whatever is deleterious and mis chievous I will give no deadly medicine to anyone if asked, nor suggest any such counsel furthermore, I will not give to a woman an instrument to produce abortion
>
> With purity and with holiness I will pass my life and prac tice my art I will not cut a person who is suffering with a stone, but will leave this to be done by practitioners of this work Into whatever hooses I enter I will go into them for the benefit of the sick, and will abstain from every voluntary

into being Development in these fields made possible a scientific understanding of how the body uses air and foods

It was not, however, until the nineteenth century that the principles of modern medicine were clearly formulated In the early part of this century significant studies concerning the fundamental nature of protoplasm were made and modern biology began to appear By the end of the first quarter of the nineteenth century the microscope had been greatly improved This gave scientists a tool by means of which much valuable knowledge has been acquired in medicine and many other fields

The beginnings of preventive medicine About the middle of the nineteenth century a cholera epidemic occurred in London and Dr Snow, a London physician, made a most important discovery regarding the way in which it spread He found that many of the cholera victims had been drinking the water of a certain well Although the germ causing this disease was not discovered until later, his investigation constituted very strong evidence that the water of the well was contaminated He set forth his findings in an able report which aroused a good deal of public interest both in Great Britain and in other countries, including the United States, and was instrumental in stimulating the advance of sanitary measures throughout the civilized world Indeed, modern sanitation may be considered as coming into existence at this time

Shortly after the start of the movement for better sanitation the sciences of bacteriology and *immunology*, the latter science dealing with the defenses of the body against certain types of disease, were born, and their progress has cleared the way for the advance of the modern public-health movement Pasteur working in France and Koch in Germany were the outstanding pioneers in bacteriology and immunology Their discoveries began to appear about 1875 Their researches and the work of others made it evident that many diseases are produced by microorganisms attacking the human body Now, for the first time in human history, scientists had succeeded in isolating certain microscopic or-

ganisms capable of producing disease This led to the discovery of better methods of combating them and as a result some of the worst enemies of mankind were hunted down and destroyed

Kinds of diseases There are different methods of classifying diseases For the purpose of obtaining some general information regarding their nature and origin we shall discuss them under the following designations degenerative diseases, tumors which include cancerous growths deficiency diseases, allergies, functional diseases, acute poisonings, industrial diseases, and communicable diseases

The *degenerative diseases* are caused by a breaking down of one or more of the vital organs The most common are heart disease diseases of the arteries and kidney disease Heart disease is now the leading cause of death in the United States In part, the degenerative diseases are the consequence of wear and tear incident to the worries and strains of everyday life Frequently, these diseases are also the result, at least partially, of one or more of the communicable diseases contracted earlier in life Thus, although the death rate during school age is the lowest of any period of corresponding length, it not infrequently happens that the diseases of childhood leave their effects in the weakening of some vital organ so that in later life, it is unable to continue to do its work efficiently

Since the beginning of the twentieth century degenerative diseases have been increasing whereas most of the communicable diseases have been decreasing Because the communicable diseases, as a group are more prevalent before maturity is reached, the result has been to increase the average length of life Before bacteriology came into existence, that is, about sixty or seventy years ago, the average length of life was around forty five years Now the average is about sixty years Naturally more people are now dying of diseases which are for the most part characteristic of middle and old age

Tumors are abnormal growths within the body They are usually classified as either benign or malignant A benign tumor is

localized in its growth but may produce death, if located in a vital organ The malignant types are commonly called *cancers* and are always fatal unless destroyed or removed in an early stage Cancerous growths are capable of being spread by the blood stream, whereas benign tumors are not capable of reproducing themselves in other parts of the body

By the prompt use of radium, X rays, or surgery it is possible in many instances to stop cancerous growths Growths in or on internal organs are naturally more difficult to eradicate than those on or near the surface of the body Although the exact cause of tumors is not known, there is evidence to indicate that heredity is a factor in some cases, and that continuous irritation may also constitute a predisposing condition Any abnormal lump on or beneath the skin should receive prompt medical attention as it may constitute the beginning of a tumor

Deficiency diseases may result from a lack of certain vital elements in the diet or from an ineffective functioning of some part of the body Thus a lack of specific vitamins may produce characteristic diseases This subject will receive attention in the chapter on foods Certain glands of the body may fail to function normally and diseased conditions or abnormalities may result Instances of this type of disorder will also be discussed later One illustration might be mentioned here, namely, diabetes, which is caused by a deficiency in the production of an internal secretion made by the pancreas

Allergies are disorders resulting from an unusual sensitivity to various proteins Thus, individuals whose nasal passages are sensitive to certain pollens suffer from *hay fever* *Asthma* is also an example of an allergic disease, in this case the linings of the bronchial tubes are hypersensitive to protein substances which may come from outside the body or from bacteria within it Hives certain digestive disturbances, and some headaches are also of allergic origin Shell fish, strawberries, eggs, milk, and other kinds of foods may produce more or less violent reactions in some people In recent years considerable progress has been made in meth-

ods of accurately determining the types of substances to which certain persons may be hypersensitive, and some success has been attained in producing immunity against these various allergic conditions

The *functional diseases* are characterized by the failure of one or more organs or systems of the body to function normally, although the tissues involved appear to be healthy. Among the most common functional disorders are certain types of nervous diseases and some forms of *psychoses*, or derangement of the personality, that are commonly referred to as insanity

As examples of *acute poisoning* alcoholism may be mentioned, and the poisoning that results from eating foods in which certain bacteria are present The bacillus botulinus and certain forms of staphylococci are the usual causes of food poisoning This type of poisoning will be discussed later in our study of foods

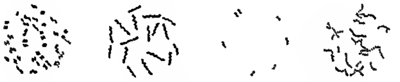
Certain industries, whose workers frequently develop one of the so called *industrial diseases*, constitute distinct health hazards Among them are industries where irritating dusts must be breathed Stonecutters, for example, may develop *silicosis*, a disease caused by the inhaling of stone dust into the lungs Workers with radium paints sometimes become victims of *radium poisoning*, while *lead poisoning* is fairly common among painters and others who handle lead products

The *communicable*, or *infectious diseases*, are caused by living organisms, among which are certain varieties of the following named forms *bacteria*, which are one-celled plants, *protozoa*, one-celled animals, and *filtrable viruses*, which are so small that they cannot be seen by the most powerful microscope and can pass through the finest filters capable of straining out bacteria Other disease producing organisms are certain worms and some types of molds and insects

Examples of diseases produced by protozoa are malaria, certain tropical fevers, and amebic dysentery Filtrable viruses produce the common cold, rabies, smallpox, measles, infantile paralysis,

yellow fever, and many other types of disease Among the worms which produce disease are hookworms and tapeworms

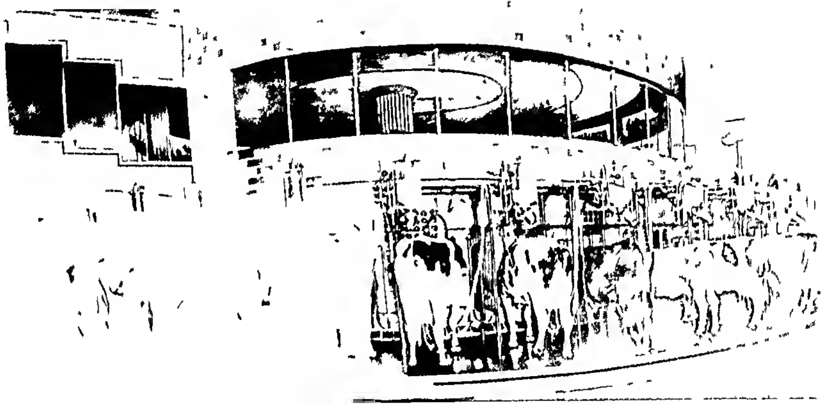
Bacteria There are many kinds of bacteria Most of them are beneficial in their effects upon mankind The bacteria of decay which are saprophytic break down nonliving organic matter into chemical substances which are again usable for the building up processes of green plants *Saprophytes* live upon decaying organic matter in contradistinction to *parasites*, which live in or upon living organisms Other beneficial bacteria are the lactic acid bac



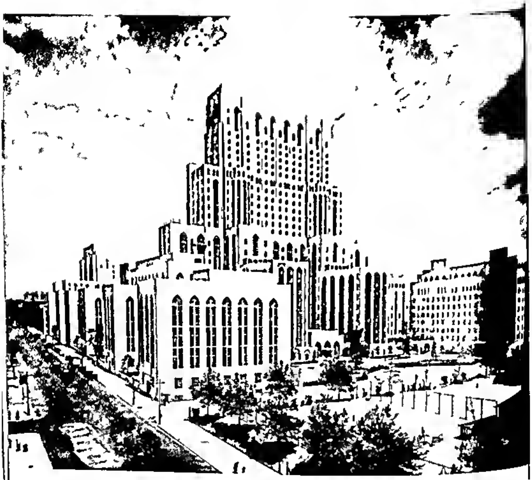
Typical forms of bacteria.

teria which make milk sour and the colon bacilli in the intestines, which break down food residue before it passes from the body

However, in this chapter our concern is with the *pathogenic*, or disease-producing bacteria which are parasitic upon the human body They are commonly called germs They all reproduce by dividing and under favorable conditions of heat moisture, and food supply, such as exist in the human body may multiply very rapidly Millions may form from a single bacterium in twenty four hours. They are grouped according to their shape and methods of division The *bacilli* are rod shaped cells—bacillus comes from the Latin word which means walking stick—and after division either remain as single cells or form aggregates or chains. One type of bacillus produces tuberculosis another diphtheria still another typhoid fever and another tetanus, or lock jaw The *cocci* are of spherical shape and form different kinds of groupings as they divide There are diplococci which remain in pairs gonorrhea and pneumonia are caused by diplococci The strep-



Methods of safeguarding the purity of milk have contributed in a large measure to the reduction of tuberculosis typhoid fever scarlet fever diphtheria and septic sore throat (*Walker Gordon Company*)



In modern medical colleges the students are given a public health point of view as well as instruction in the treatment of individual cases of illness (Photograph of the Cornell University Medical College New York by Ewing Galloway)

or some other substance, such as boric acid, which is not capable of destroying germs even if used in full strength Strong disinfectants cannot safely be used in or upon the body, since they destroy body tissues as well as pathogenic organisms

Sunlight destroys some bacteria when they are directly exposed to it Its germicidal power is due to the action of certain of its rays, particularly those known as ultra violet

Pasteur s discovery of the principles of sterilization Before Pasteur (1822-1895) performed certain epoch making experiments, scientists disagreed as to whether certain low forms of life might come into existence spontaneously or whether they always came from organisms of their own kind He demonstrated that if nutrient material were thoroughly sterilized and not contaminated by air containing any of the various invisible forms of life, such as the spores of organisms, like yeasts, molds, or bacteria, it would remain sterile indefinitely This work is generally recognized as having been one of the most significant scientific demonstrations ever made Among other things, it pointed the way to *aseptic surgery*, that is, surgery that is not followed by *sepsis*, or blood-poisoning It was found that wounds will heal without forming pus, or *suppurating*, provided they are kept sterile This means that the conditions under which operations are performed must be of such a nature as to prevent, as far as possible, the entrance and growth of certain bacteria that had previously, in practically all cases, gained access to wounds and produced infections.

Pasteur also found that by heating fermenting liquids, such as wine and beer, to a certain temperature, and by maintaining that temperature for a given period of time, it became possible to kill certain microorganisms whose presence destroyed the flavors that were desired, although other organisms were not affected by the heat In other words, he discovered a method of *selective sterilization* which has since been applied to the treatment of milk for the purpose of destroying certain pathogenic bacteria that are sometimes present in it This process has been called *pasteurization* Thus it is possible to destroy microorganisms which are some-

times present in milk and which are capable of producing such diseases as tuberculosis, diphtheria, scarlet fever, typhoid fever, and septic sore throat In pasteurization the milk is rapidly raised to 142° F and maintained at that temperature for a period of thirty minutes, after which it is rapidly cooled and kept a few degrees above freezing

Methods of controlling the spread of communicable diseases One general method used in attempting to control the spread of certain communicable diseases is the *isolation* of those affected With some diseases it is desirable to *quarantine*, or isolate, persons who may have come in contact with the sick Among the diseases in which isolation or quarantine or both of these procedures should be practiced are the following smallpox, scarlet fever, diphtheria, whooping cough, infantile paralysis, and measles The rules for isolation or quarantine vary with different diseases They depend, among other things, on the length of the *incubation period* of the disease, by which is meant the time that elapses between the contraction of the disease and the manifestation of its symptoms

A specific method of controlling certain of the communicable diseases, such as typhoid fever, diphtheria, smallpox, and scarlet fever, is by establishing an *immunity*, or ability to resist the diseases, in people who are susceptible to them Immunity is always specific, that is, it is not general but exists only to a specific disease

One of the difficulties of controlling communicable diseases is that they may be spread by human 'carriers' who apparently are well In some cases the carriers have had an attack of the disease and although they have recovered, their bodies continue to harbor the infective organisms instead of destroying them as is usually the case In other cases carriers have, or have had, so mild an attack of the infection that they have not been made sick by it Their bodies have acquired a tolerance for the bacteria Still a third type of carrier is the entirely well person who remains unaffected by the disease producing organisms in his body All of

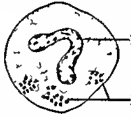
these types of infected individuals give off the bacteria in one or more of their discharges If these organisms gain access to the bodies of other people who are susceptible, they may set up an active infection This is one of the reasons why it is very important for cooks in restaurants, dairy men, and other types of food handlers to receive periodic physical examinations They should be trained to be scrupulously clean in their personal habits It should not be inferred from these statements that all infectious diseases may be spread by human carriers, in fact, the number of diseases of this type is limited Among the most common are typhoid fever, diphtheria, and pneumonia

II. DEFENSES OF THE BODY

The external defenses The defenses of the body against the attacks of disease-producing microorganisms are of two types external and internal The external defenses consist principally of the skin and *mucous membranes*, or linings, of the mouth, nasal passages, throat, windpipe, alimentary tract, and the tubes which are found in the genito-urinary system We may also include as external defenses the hairs of the nose, microscopic hairlike projections in the windpipe, which by their movement keep dust particles from settling in the lungs, and certain secretions of the body like saliva and gastric juice, the former keeping down the growth and reproduction of certain bacteria and the latter killing many forms

The internal defenses at work To get a picture of what happens in the body when certain pathogenic microorganisms have passed its external defenses and entered the tissues or blood stream, let us take the case of the common boil Most boils are due to the staphylococcus, one of the pus forming bacteria When a boil forms in the skin it is because interactions are taking place between the bodily defenses and the bacteria which have begun to grow, reproduce, and cause irritation around the hair root. An infection is started In the course of the infection the blood vessels

in the neighborhood are enlarged, permitting more blood to enter them The fluid part of the blood accumulates in the tissues and *leucocytes*, the white cells which are present in both blood and lymph, appear in larger numbers than usual in the infected area, and many of them pass through the walls of the blood vessels The affected part becomes inflamed The extra amount of blood naturally causes redness, heat, swelling, and pain—conditions that always accompany inflammation The pain is due to the extra amount of pressure upon nearby nerves



Phagocytosis A leucocyte which has ingested bacteria

It is the presence of the extra blood, however, which, even though it causes the discomfort of the inflammation, permits the body to defend itself against the infection, for the agents which are needed to destroy the bacteria are in the blood The increased amount of blood assists in assembling them in greater quantities at the point of infection In the blood of all normal individuals there are certain white cells, called *phagocytes*, which, if conditions are favorable, proceed to ingest and digest the staphylococci This process is called *phagocytosis* If they can destroy the germs faster than the latter can multiply, the bodily forces win and the boil 'comes to a head" However, a substance that has never been seen but which, from its effects, is known to exist, must be present in the blood to make it possible for the phagocytes to attack the bacteria This substance is called *opsonin*, and the increased number of leucocytes in the blood during infection is called *leucocytosis*

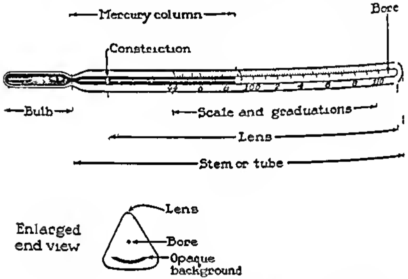
To determine the possible presence of infection and whether it is increasing in severity, the leucocytes in a very small quantity of blood may from time to time be counted This is part of the procedure of making a "blood count" The normal number of leucocytes in a cubic millimeter of blood is about 6 000 In leucocytosis it may be increased by many more thousands A greatly increased number indicates the presence of an infection In suspected cases of appendicitis, for example, the blood count may be a great help in diagnosing the disease

In the case of a boil, as the result of the interactions taking place between the bacteria and the phagocytes, pus is formed in the hollow which has been made by the destruction of tissue If this pus is examined microscopically, it is found to be made up of some dead leucocytes and staphylococci living leucocytes, lymph, and certain partially or wholly dissolved tissue cells When the boil or abscess breaks and the wound begins to heal, the pressure on the nerves becomes less, the swelling and redness gradually diminish, and the pain is relieved *Scar tissue* is formed which takes the place of that which has been destroyed

The scar tissue consists of connective tissue cells which, of course, cannot carry on the functions of the destroyed tissues The organs of the body, however, can usually adjust fairly well to such damage since they have an excess of vital tissue, that is, more than is necessary to function efficiently under ordinary conditions In some inflammations, such as may occur in the intestines, scar tissue forms *adhesions* which interfere, to a greater or less extent, with normal functioning

The fever and inflammation that usually accompany infections were formerly thought to be wholly injurious in their effects upon the body Now it is known that they are in reality defense mechanisms In treating some diseases it has actually been found beneficial to induce a fever in the body since it has been discovered that some germs, such as those which cause syphilis and gonorrhea, may thus be destroyed So called fever boxes are being used extensively today in attacking these diseases

Measuring temperature Fever is a rise above normal in the temperature of the body It is a symptom of many diseases Because of its significance in helping to determine the degree of virulence of an illness it is important for a physician to know the amount of the rise in the temperature of a patient The tempera



The clinical thermometer (after Becton Dickinson and Co Rutherford N J)

ture may be obtained with an instrument called the *clinical thermometer*

The average normal temperature of the human body which is usually taken under the tongue is 98 6° F Slight variations from this temperature do not necessarily indicate sickness since people vary in their temperatures as in every other characteristic To vary slightly at different times in the twenty four hour period is normal The temperature in the early morning is normally one to three degrees lower than in the evening and there is a constant difference in the temperature of various parts of the body In the rectum it is usually a degree or so higher than under the tongue

The clinical thermometer employs the same principles as the ordinary *thermometer, but with certain differences that make it* usable for measuring human temperature The making of a thermometer depends upon the fact that liquids expand when temperature rises and contract when temperature falls The ordinary thermometer consists of a glass tube with a very *small bore from* which all air has been expelled, and which is sealed at one end and attached to a glass bulb at the other The bulb is filled with a liquid that does not freeze at ordinary temperatures Mercury is the liquid generally used because it is very sensitive to changes *in temperature Since it freezes at 38° F below zero* alcohol which freezes at o 9° F below zero is used in colder climates The vacuum in the bore above the liquid permits it to move freely up and down the tube as it expands or contracts according to the rising or falling of the temperature The tube is marked off into *degrees to measure these changes*

For marking thermometers in general use there are two different scales the Fahrenheit and Centigrade In the Fahrenheit scale the freezing point of water is marked at 32° and the boiling point at 21 ° The freezing point of water in the Centigrade scale is 0° *and the boiling point 100°* The latter is a more convenient grading and is generally used for scientific *purposes* In many *countries* it is the only scale used In the United States and Great Britain the Fahrenheit scale is in common use For the sake of convenience the letters F and C are used respectively for Fahrenheit and Centigrade The Fahrenheit scale is used for the clinical thermometer *in the* United States. Its range is 94° F to 110° F which for all practical purposes, is the variation in the range of human temperatures

The pocket thermometer was invented about 1864 The improvements that made a clinical thermometer practicable are the magnifying lens which was patented in 1870 and the self registering device which was made first about 1880 This latter device prevents the *mercury* from moving freely up and down the tube with changing temperatures The heat of the body causes the

mercury to expand and move up from the 94 degree level. It remains at the highest point it attains when a temperature is "taken," in this way registering it. It is interesting to know that the size of the bore in a clinical thermometer is less than the diameter of a human hair. Since a reliable clinical thermometer is a delicate instrument it should receive careful handling. It should not be washed in water over 110° F. for a temperature higher than its range will break it, but before each use should be sterilized in alcohol.

Antigens and antibodies. Phagocytosis is not the only means of internal defense of the body against microorganisms and other foreign substances. The other weapons consist, in large part, of certain materials in the blood which resist the invasion of foreign substances and which are called *antibodies*. Their presence and amount in the blood determine the immunity of a person against many diseases. They have never been seen or isolated, but their presence is detected by their effects in helping the body to overcome infection. An invading substance which causes the formation of antibodies is called an *antigen*. Antigens are specific in the infections which they establish, and it is believed that the antibodies which destroy them or neutralize their poisons are also specific, that is, for each antigen there is believed to be a specific antibody.

The specific types of reactions caused by antibodies vary with the nature of the antigens. Opsonin acts as an antibody and prepares the specific bacteria which invoke phagocytic action for destruction by the leucocytes. If the disease results from toxins released by bacteria, as in the case of diphtheria, the antibody is called *antitoxin*. *Agglutinin* is another type of antibody which makes its appearance under certain conditions, such as exist in typhoid fever. This substance causes typhoid fever bacilli to stop their movements and come together in small groups, or agglutinate. The agglutination appears to weaken the bacteria although it does not actually destroy them. There are still other

types of antigen-antibody reactions which we shall not discuss here

Protective reactions are much more effective against certain types of microorganisms than against others Certain forms of bacteria, for example, are always present in our mouths, digestive tracts, and skin, and yet they ordinarily do no harm If, however, our bodies become weakened by over fatigue, exposure, excessive use of alcohol or of some drug, or by insufficient food and clothing, our protective reactions tend to become less efficient, our resistance is lowered, and these organisms may be able to become active and set up infections Under conditions favorable to their growth they may produce colds, boils, digestive disturbances, or more serious disorders Thus our bodies may, for certain periods, be immune to some microorganisms yet may, at other times, be susceptible

Types of immunity In general, immunity is either natural or artificially acquired *Natural immunity* may be either inborn or acquired during one's life *Naturally acquired immunity* may result from having had certain diseases, such as smallpox or diphtheria There are two types of *artificially acquired immunity* One type results from introducing the antigens, in a modified and weakened form, into the body for the purpose of stimulating the production of antibodies This is called *active immunity* In the other case antibodies, which have already been made in some other person or animal, are injected into the individual The immunity thus produced is called *passive immunity*

The reason for using the terms "active and 'passive is self-evident in developing active immunity the body of the individual concerned produces its own antibodies, in passive immunity antibodies needed to fight the disease are elaborated in some other animal In the latter case the body is passive, merely receiving the antibodies that were made elsewhere In the former case the body is called upon to manufacture its own weapons, in other words, it is active

To produce active immunity the specific organisms capable of

plants, different types of pathogenic microorganisms are capable of producing diseases in certain kinds and not in others It is reasoned from such facts that the tissues of different species of plants and animals must vary somewhat, so that whereas some of them furnish a congenial "soil" for the growth and development of certain disease producing organisms, others do not.

It is not species alone that vary in regard to immunity There is also variation among the different races of mankind Therefore it is proper to speak of *racial immunity* For example Negroes are not so susceptible to malaria and hookworm as the white races, but the whites appear to have a greater degree of immunity against tuberculosis In general, it may be said that wherever a disease has been prevalent in a region for a period of time extending through many generations, the people living in that region are apt to show a greater degree of immunity to it than people living where the disease has recently been introduced The Negroes, for example, have been exposed to a greater extent than most other races to malaria, but they have not, until recently, lived where tuberculosis is prevalent Judging from these and other observations it is inferred that there has been a weeding out of the most susceptible individuals living in places characterized by the presence of certain diseases. In this way there appears to have been a selective action exerted upon the *germ plasm,* or reproductive cells, so that the unfit have been killed off

In addition to species and racial immunity it is a matter of common observation that susceptibility or immunity to certain diseases runs in families There is strong evidence to indicate that weaknesses which constitute tendencies toward certain diseases are inherited Tuberculosis and cancer are cases in point There are apt to be differences in the degree of immunity to certain diseases possessed by some family groups as compared with other similar groups, but the matter does not stop there There are individual differences among members of the same family and there are differences in the degree of immunity in regard to certain diseases during different periods of life

III THE RISE OF BACTERIOLOGY

Edward Jenner's epoch making discovery Edward Jenner, an English physician, was the first to practice vaccination as a preventive measure against *smallpox* Before his time it had been noticed that persons who milked cows that had a certain type of sore on their udders, and who themselves developed slight sores on their hands as a result, did not get smallpox Having observed this reaction Jenner began to inoculate his patients with some material taken from the sores, which we now know contained *cowpox virus* The result was that although most, if not all, of them were undoubtedly exposed to smallpox (since nine out of ten persons reaching maturity in his day had contracted the disease), none of them became infected His first vaccination, or inoculation with cowpox virus, was made in 1796 Apparently no one before the time of Jenner had conceived of the possibility of preventing people in general from getting this disease by introducing into the skin some material taken from the sores of cows Jenner did not understand the principles underlying vaccination, for the germ theory of disease and the principles of immunity were not formulated until several decades later

Between 1799 and 1801 three thousand persons were vaccinated with cowpox virus in the London Smallpox Hospital and afterwards inoculated with smallpox virus, and yet not one of them developed the disease Soon the news of this discovery spread far and wide with the result that vaccination began to be practiced in many places It was found that where vaccination was made compulsory smallpox practically disappeared, but if it was not generally practiced, epidemics of the disease might arise at any time This condition is just as true now as when vaccination first became general

There can be little question but that the cowpox and smallpox viruses have descended from a common ancestor The cowpox variety is unable to produce a serious illness The early descend-

ants of the original form which took to living in human beings became the smallpox virus and were more successful in developing means of injuring their hosts The two forms, however, are sufficiently alike in the ways in which they affect the body to make possible the use of the weaker variety in order to produce an immunity against the virulent type

Additional facts about vaccination (1) Vaccination which 'takes' usually gives an individual immunity against smallpox that lasts on an average of five years, although in many cases it continues longer

(2) Vaccinated persons who may contract the disease practically always have lighter attacks than unvaccinated individuals

(3) The improvement of sanitary conditions has had little to do with reducing the *incidence* of the disease, by which is meant the number of cases in a given period among the general population

(4) The preparation of the vaccine is conducted in the most careful manner under government supervision

(5) There is practically no danger of infection if the doctor who vaccinates uses reasonable care to avoid infection of the wound, and if, after vaccination, instructions regarding its care are followed

These facts should convince anyone who is unbiased of the necessity for vaccination against smallpox Some persons however, reasoning from false or insufficient data, declare that vaccination either should be abolished entirely or made optional with each individual, that in a democracy there should be individual freedom in matters concerning health They fail to recognize the desirability of curtailing individual freedom when it menaces the well being of large numbers of people, and that the policy of requiring people to be immunized against certain diseases, not only for their own good but for the protection of society, is more in harmony with a democratic spirit than their own attitude

Pasteur and the rise of bacteriology We have already stated that there are two outstanding pioneers in the science of bac-

teriology—Louis Pasteur, the Frenchman, and Robert Koch, the German The name of another man should be mentioned in connection with the work of Pasteur, an English physician, Lord Lister, who kept in close touch with Pasteur's discoveries and applied them in his practice as a surgeon

Pasteur began his lifework as a chemist He became interested in the study of fermentations, especially with reference to the wine making industry of France A little later he devoted several years to the study of a serious disease of silkworms, which was threatening to wipe out the silk industry in his country Then he turned his attention to the study of methods of combating certain diseases of domesticated animals, and finally found himself in the field of human diseases

Pasteur was an indefatigable worker and his personality was such as to attract other individuals who became imbued with his spirit and devoted themselves wholeheartedly to whatever tasks he assigned them Among these men were some with medical training, the most outstanding being Chamberlain and Roux, who supplemented what was lacking in his own training and experience Pasteur furnished the inspiration and most of the ideas which made possible certain epoch making discoveries in the field of preventive medicine

Pasteur was not a medical man himself and frequently antagonized many of the leading physicians of his day, who at least in the early period of his work, were apt to look upon him as an intruder and meddler whose theories were not to be trusted Toward the latter part of his career, however, Pasteur and those working with him in the field of bacteriology succeeded in winning over the medical profession Then he received the highest honors that might be conferred upon any worker in such a field

We must be content here to mention a few of the most outstanding accomplishments of this great man We shall pass over his work as a chemist and investigator in the field of fermentations and of the disease of silkworms, which alone would have been sufficient to have given him high rank as a scientist, and

consider some of his accomplishments in the field of preventive medicine

Pasteur's work with chicken cholera bacilli Pasteur observed certain similarities between the phenomena connected with disease and the fermentation of wines He had found that fermentation was due to the activity of microorganisms, especially yeasts, and he was able to demonstrate the existence of bacteria in the blood and other tissues of animals when certain diseases were present He found that when anthrax bacilli were introduced into the bodies of sheep and cows there followed a period of incubation which corresponded to the incubation of yeast in wine He found that during this period the bacteria multiplied rapidly in the blood of these animals, in a few days setting up a disease, anthrax, which usually proved fatal The blood of the diseased animals was literally alive with anthrax bacilli He grew these organisms in his laboratory and could produce the disease in other animals at will

At the time that he was working with anthrax bacilli he was also experimenting with the bacteria which produce chicken cholera While he was conducting experiments with fowls he discovered the underlying principle of active immunization Because of its epoch making significance we shall outline the story of how this was done His experiments involved the inoculation of fowls with chicken cholera bacilli It so happened that at one time there were no fresh cultures of this organism at hand in his laboratory Therefore, he used old cultures, the only material available After inoculating a number of chickens with these organisms he had occasion to leave Paris for some weeks Upon his return he was surprised to find that all of the chickens which he had inoculated were just as well as they had ever been He had expected to find them dead since all previous inoculations with cholera bacilli had proved fatal

Later he took fresh cultures of chicken-cholera bacilli and inoculated them into the fowls which had survived the inoculation with the old cultures, and again to his surprise he found that the fowls survived the attacks of the virulent organisms. He used

cine Immediately, requests came from all over Europe for anthrax vaccine

Discovery of the Pasteur treatment for hydrophobia Another noteworthy accomplishment was the development of a method of successfully combating *rabies*, or hydrophobia a disease which develops in persons who have been bitten by mad or rabid animals The development of this method was preceded by many experiments and failures, but finally, in 1885, it was used for the first time upon a human being The principle involved is the same as in the case of immunization against smallpox chicken cholera, and anthrax—that is, use is made of a vaccine To secure this vaccine many experiments were made The attempts to isolate the virus causing rabies and to grow it in media outside the body were unsuccessful, and there was no weakened type of kindred organism available as in the case of smallpox

After many fruitless attempts to secure a vaccine, such as by using the saliva of rabid dogs—which, by the way, involved a great deal of courage in its collection—a method was finally devised which became known as the Pasteur treatment for rabies This consisted of placing some of the infectious material from the brain or spinal column of an animal which had recently died of rabies in the brain of a well animal Rabbits were used for this purpose The animals so treated developed the disease After their death the spinal cord was found to contain the rabies virus This cord was treated in such a way that a carefully measured amount of it could safely be inoculated into a well person in whom it was desired to establish an immunity As a result of a series of such inoculations it was found possible to establish this immunity Naturally, the experimental work was done upon animals

The method which was originally used in Pasteur's laboratory has been modified, but the fundamental principle involved is followed today Instead of rabies being fatal in practically all cases it is now possible to save the lives of almost all those who have been bitten by a mad animal, provided such persons receive prompt treatment.

become established, grow very rapidly, and produce a membrane on the surface of the tonsils or pharynx This diphtheritic membrane is formed very quickly and since there is not time for the development of an immunity by vaccination some other method of protection was devised

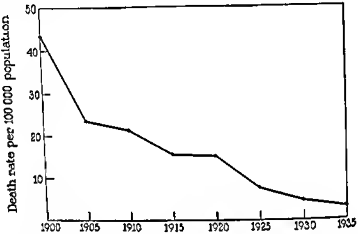
It was found after much experimentation that the blood of animals, into which carefully measured amounts of the diphtheria toxin were introduced, developed antibodies Their blood serum could then be used to protect human beings against the attacks of the toxin It was discovered that the horse could withstand a great quantity of the diphtheria toxin as compared with other animals By gradually increasing the amounts of toxin introduced into the blood of the horse chosen for the purpose the animal develops the ability to withstand doses which would kill several normal horses From the blood of animals so immunized great quantities of antitoxin can be obtained

The human body reacts to diphtheria toxin in a manner similar to that of the horse It was found that the antitoxin produced as we have just described, might safely be introduced into human beings The result of such inoculation, when used in proper quantity and strength by individuals in the early stages of the disease, has been found to be effective in helping them to overcome the attacks of the microorganisms because ready made antibodies are furnished to counteract the toxin of the diphtheria bacilli This antitoxin, if given soon after exposure, is also efficacious in preventing a person from contracting diphtheria after he has been exposed to it The use of antitoxin as described above constitutes an emergency type of treatment and sets up a passive immunity

The antitoxin treatment for diphtheria was announced in 1894 As its use became more and more general the death rate from this disease was correspondingly reduced until now it is only a very small fraction of what it was prior to that time Although this reduction is owing, in part, to the use of antitoxin, there were factors of even greater importance, chief of which has been the

discovery of a method of producing active immunity against diphtheria

The use of toxoid In recent years it has been found possible to produce what appears to be a lifelong immunity against diphtheria by the use of ***toxin antitoxin***, a mixture of toxin with antitoxin, or better still of ***toxoid*** which is a modified form of the

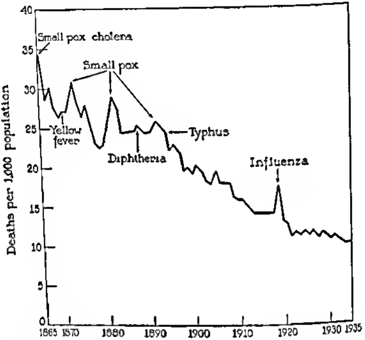


Reduction of deaths from diphtheria United States Registration Area 1900 1935 (*From* Mortality Statistics U S Census Bureau)

diphtheria toxin Both of these preparations when inoculated into the body stimulate it to produce antitoxin A single inoculation of toxoid is usually all that is required to produce an immunity against diphtheria, although two are frequently given, whereas if toxin antitoxin is used, three injections are necessary

The greatest number of cases of diphtheria appear in children under seven years of age Public health authorities are therefore urging the immunization of all infants against diphtheria Most new born infants possess an immunity against diphtheria which usually disappears in a few months If they are immunized while still infants, that is, before they are a year old, they are protected during the most susceptible period, and they are usually immune for life Doctors recommend this inoculation at about the ninth

with it, and it must be grown in a separate culture in the laboratory (3) The organism must then be inoculated in a pure culture into the bodies of healthy animals and must be observed to produce the same disease in them as in man (4) Finally, the same



Declining death rate in New York City showing the number of deaths per 1 000 population through a series of years indicating effects of epidemics (*From* Department of Health City of New York)

kind of organisms must always be recovered from the bodies of the sick animals or from those that have died from the disease

Lord Lister's applications of the facts of bacteriology Discoveries in the field of bacteriology were significant in advancing the well being of mankind in many ways in addition to those that have now been mentioned Lord Lister was a pioneer in the application of these discoveries Until his time it was thought necessary for wounds made during surgical operations to produce

pus before healing In many instances they never healed at all, as a large percentage of surgical cases died of blood-poisoning resulting from operations

Lister was the first to use antiseptic measures for the purpose of avoiding infections of this type His methods were founded upon the discoveries made by Pasteur, for he recognized the fact that pus was produced by bacteria getting into wounds and that if wounds could be kept sterile, infection would be prevented, thus the chances of recovery from the operation increased

Pasteur had demonstrated that bacteria are present in the air and Lister became convinced that they were the cause of the suppuration that usually developed in wounds following operations and in other kinds of open wounds He had puzzled over the reason why simple fractures healed successfully, while dangerous complications usually arose in compound fractures (see page 111) Pasteur's theories that germs originate only from other germs like themselves and that they are the sources of the decomposition of organic matter seemed to Lister to offer a possible explanation of the cause of the formation of pus in wounds

It had recently been discovered that carbolic acid could be used successfully to deodorize sewage Lister believed this acid had germicidal properties His first experiment with it, in 1865, was on a compound fracture This experiment was a failure, for the patient died, but he continued the use of carbolic acid on other cases of compound fractures, developing a method which met with almost uniform success He applied carbolic acid daily, until all danger of suppuration was past, to the wounds made by the ends of broken bones Because this method of using carbolic acid was not practicable in the case of operative wounds, he devised a way of spraying the air around the wound with carbolic acid Also dressings, instruments, the surgeon's hands, and the skin of the patient around the wound were washed with it Later experiments of his own and of other workers convinced him that the bacteria of the air were not a source of infection in operations and that the successful results of the use of the

PART TWO

THE BODY: ITS FUNCTIONING AND CARE

to the maintenance of a high standard of healthful living.

Energy and activity. Energy can be manifested only by activity, and activity involves movement. The movements of the human body are made possible by the functioning of its muscles, working with the assistance of the other parts of the body. Those which concern us principally in a discussion of posture, exercise, and rest are the *skeletal muscles*, or muscles which are attached to bones, and which by their alternate contraction and relaxation help to produce the more obvious movements of the body. The skeleton gives shape to the body and makes possible the effective contraction of the muscles which are attached to it. If it were not for the skeleton, the body would be like a jellyfish and the contraction of its muscles would merely result in quivering movements.

Exercise desirable for all healthy people. Exercise of the large muscles of the trunk, arms, and legs is necessary for the maintenance of health and vigor as well as for good posture. Some people secure enough of this exercise incidentally as a part of their daily routine, but many do not. Those who lead more or less sedentary lives need to supplement their ordinary activities by additional ones which will furnish the types of exercise needed. If it is possible to combine exercise with recreation making it more enjoyable, the benefits to mind as well as body will be greatly increased. Not everyone can excel in athletics, but the great majority of people can obtain pleasure and profit from participating in some form of outdoor recreation. The person who has never learned to play and to do at least moderately well in some form of athletic activity has missed a vital experience which might have contributed to his health, both physical and mental.

Posture, an indication of the condition of the body. Human emotions, feelings, moods—personality itself—are evidenced by posture. The ways in which you stand, walk, and sit make impressions upon others which are either pleasing or the opposite. Dramatic artists, singers, and public speakers have to give particular attention to posture. However, it is a subject which should

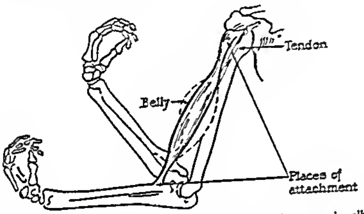
to improve their carriage markedly Many colleges offer courses in corrective exercises especially designed to improve posture The constant repetition of certain corrective movements is apt to become very boring and tiresome, especially if one does not understand just what they are designed to accomplish Therefore one needs to have a mental picture of just what is wrong with his own posture, and to know how the various prescribed exercises may change it, if he is to have the patience to carry through the program he needs

Importance of relaxation Everyone knows that it is impossible to hold the arm out straight from the shoulder for more than a few minutes The contracted muscles in the shoulder and arm ache and fail from exhaustion They must be relaxed and rested before they can be tensed again in the same position All muscular activity is carried on by the contraction of muscles The continuous contraction of any muscle will soon produce exhaustion similar to that exhibited by the outstretched arm Periods of relaxation must alternate with periods of contraction, if the muscle is to function efficiently

Relaxation is the opposite of tension When the muscles are tense they are contracted, when they are resting they are said to be relaxed Rest means relaxation Sleep, in order to be beneficial, must be characterized by relaxation A person who has not learned how to relax is injuring more than his muscular system The muscles are controlled by the brain and other parts of the nervous system Muscles strained by long continued tension overstimulate the nerves and may, therefore, set up injurious reactions in other parts of the body, thus we can easily see that there must be a proper balance between relaxation and exercise, if the latter is to be beneficial and not injurious

that when the belly of the muscle contracts, a tension is produced which ordinarily results either in a flexion or an extension of the bones, depending upon the location of the muscle and the places where the tendons are attached. An example should make these statements clear

When the arm is bent at the elbow the large muscle in the front, the *biceps*, is contracted The muscle which is antagonistic

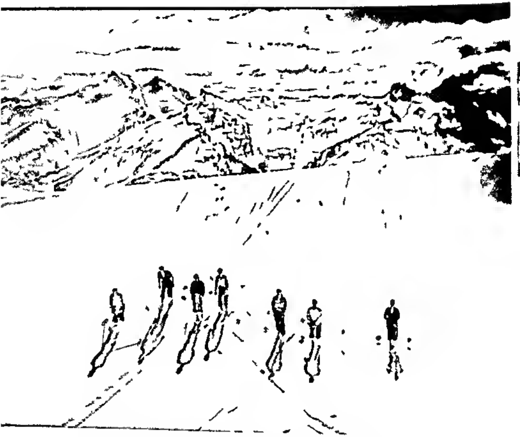


Contraction of biceps muscle with resulting flexion of arm at the elbow (*After* H N Martin, *The Human Body*, Henry Holt & Company)

to the biceps is called the *triceps* and its belly is located in the back of the upper arm. The contraction of the triceps results in an extension of the arm at the elbow If antagonistic sets of muscles contract strongly at the same time, no motion will result but merely a rigidity, or tension Bodily movements involve the relaxation of certain muscles while others are contracting, and, to be carried out effectively, require a nice timing of these contractions and relaxations

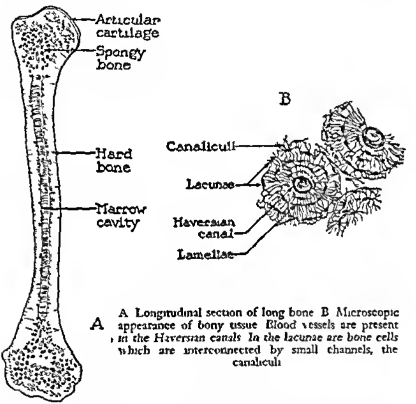
Functions of the skeleton The skeleton helps to make locomotion possible It gives shape to the body and protects certain vital organs Thus the bones of the cranium protect the brain, the ribs and part of the spinal column protect the heart and lungs, the pelvic bones protect the organs lying in the lower part of the trunk.

Posture bad__________and__________excellent



An ideal sport for winter skiing is becoming more popular every year *(Ewing Galloway)*

may be formed If she does not eat enough bone-forming food, some of the material needed to form the bones and start the development of the child's teeth will be extracted from her own body Since bones are composed largely of calcium carbonate and



A Longitudinal section of long bone B Microscopic appearance of bony tissue *Blood vessels are present in the Haversian canals In the lacunae are bone cells which are interconnected by small channels, the canaliculi*

calcium phosphate, and since milk is rich in these substances, its use is especially desirable for pregnant women and is essential for the normal growth of children Phosphorus is found also in meats, fish, potatoes, beans, and peas, as well as in certain other foods Vitamins C and D are also important in *ossification*, or bone formation Citrus fruits are rich in vitamin C Egg yolk, cod liver oil, and viosterol are sources of vitamin D Rickets, which is

caused by lack of vitamin D, constitutes one of the chief results of the slow or faulty development of bones and teeth In its more pronounced form it is characterized by "pigeon breast," knock-knees and bow legs

Internal secretions and the growth of bones At the base of the brain there is a small structure which plays an important role in the functioning of the body Among other things it helps to control the development of the skeleton It is known as the *pituitary body* and is one of the glands producing internal secretions (See p 49) It consists of two lobes or parts, an anterior and a posterior, which are united by a middle portion This gland is extremely important, producing not just one hormone but several One of the secretions made by the anterior lobe controls the development of the skeleton The typical giants, like those exhibited in circuses possess pituitary bodies which have been overactive On the other hand, if too little of this hormone is produced, skeletal development is retarded The gland may become overactive in adult life and then the bones of the hands and feet and of the face especially the jaw, become enlarged This condition is called *acromegaly*

There is another internal secretion which helps to regulate bone formation This secretion is made by tiny glands, the *parathyroids*, that are close to another gland found in the neck and known as the *thyroid* The secretion made by the parathyroids is called *parathormone* It regulates the manner in which the body utilizes the calcium in the blood A deficiency of this hormone produces convulsions or involuntary muscular twitchings This condition is known as *tetany* If there is too much parathormone, the bones become soft and deformities result

Different kinds of articulations *Articulations* are places where bones come into more or less close apposition to each other Some articulations permit of no movement at all, such as those in the cranium or skull These bones dovetail into each other Some of the articulations, like those in the chest region of the vertebral column, permit of only a small amount of movement

Hinge joints permit of a considerable degree of movement in one plane The articulations at the wrists and ankles are more flexible than typical hinge joints, permitting some degree of rotation *Ball and socket joints* are found at the shoulders and hips. They are articulations in which the ball-like end of one bone fits into a cavity, allowing a very free type of rotary movement The articulation of the skull with the top of the vertebral column also permits of considerable rotary movement

The ends of the bones which form movable articulations are held in proper place by means of strong bands of tissue, the *ligaments* At the ends of these bones there is a covering which consists of a strong, smooth surface, the *synovial membrane* This membrane produces a fluid, the *synovial fluid*, that acts as a lubricant and reduces friction

Fractures, dislocations, and sprains A *fracture* is a partially or completely broken bone A partially broken bone is called a *green stick fracture*, because of its general similarity to a partially broken green stick It occurs frequently in little children because their bones are pliable A bone that is completely broken and protrudes through the skin is called a *compound fracture* One that is completely broken but does not protrude through the skin is a *simple fracture*

Where there is evidence of a fracture, the wisest procedure is to keep the injured person absolutely quiet and in as comfortable a position as possible until the services of a doctor can be secured The reason for keeping him quiet is that when a bone is completely broken, the rough edges may tear tissues and perhaps rupture blood vessels, if there is movement of the parts. If the patient has to be removed, and if the fracture is in the arm or leg, a temporary splint may be made by fastening the limb to a board or a piece of wood on which a rolled up blanket or pillow has been placed The limb should be tied to the splint above and below the place of injury and in such a manner as to prevent a flexing of the joint X-rays are invaluable aids in the correct set-

ting of broken bones and should be used both before and after the bones have been set (See p 30)

Dislocations and sprains *Dislocations* are produced when bones are thrown out of alignment at any place where there are movable articulations It is best to obtain a doctor's services, in the case of a dislocation, since anything but expert manipulation of the torn or stretched ligaments may aggravate the injury

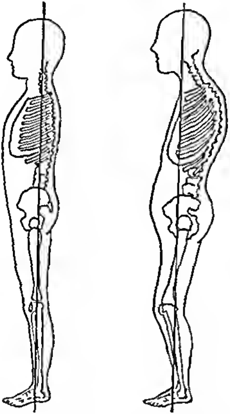
A *sprain* is caused by a sudden wrench and involves some degree of injury to ligaments and muscles Since what appears to be a sprain may involve a broken bone, it is well to secure medical attention for this kind of injury also

The vertebral column in relation to posture You have probably heard that a straight back denotes a strong back and have been told by physical education teachers to "stand tall" At home you doubtless have been urged to throw your shoulders back and not to slouch In some schools today there are facilities for taking pictures, or silhouettes, of the human body What do such silhouettes show? They enable you to compare your posture with that of other individuals of your own age and sex. By their aid you are enabled to see both the good and bad points of your own posture, especially if they are interpreted by an instructor who is an expert in this field These pictures show you if your shoulders are stooped, if your abdominal walls bulge, if your back is hollow, and how you hold your head In general, silhouettes indicate graphically body curves and carriage of head and shoulders

Good posture depends in large measure upon the condition of the spinal column This part of the skeleton supports the head With it are connected the bones forming the shoulder and the pelvic girdle with which the limbs articulate It protects the spinal cord, the largest nerve in the body It is composed of thirty three vertebrae, which are held together by strong ligaments Between most of the vertebrae are pads composed of cartilage and fibrous tissue. Each vertebra articulates with adjacent

ones As a result of its structure the vertebral column is both strong and flexible

As is the case with the other bones of the body, in childhood



The skeleton in poor posture as compared with good posture (Courtesy, U S Department of Labor, Childrens Bureau Publication No 165)

the vertebrae contain a larger proportion of cartilaginous material and the ligaments connecting them are softer At birth the backbone is very flexible and particular care should be taken to prevent injuries to the back during infancy and childhood Effort should be made to strengthen the back muscles by exercise and play of a type to develop them Heavy loads should not be car-

ried by children for they put a strain on muscles and bones not strong enough to bear them Especially, strain should not be put more on one side than on the other

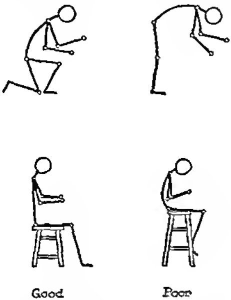
There are four normal curves in the back, from the head to the lower end of the vertebral column One or more of these curves may become exaggerated when back muscles are weak from lack of development or when the spinal column is malformed because of *congenital* defect, or defect present at birth, from nutritional deficiency, disease, injury, or bad postural habits A "hollow back" means too great a curve in the small of the back It is apt to be associated with a bulging outward of the abdominal walls and usually produces backache If the back bulges too much at the shoulder region the shoulders are "stooped"

Usually when spinal curvature is mentioned, a sidewise or lateral deviation is meant In this condition the vertebrae are out of line with each other in a vertical direction It may be congenital or it may result from causes such as those mentioned above—an injury, or illness like infantile paralysis, or an habitual wrong posture In all of these conditions, when at all marked, expert attention is needed in attempting to correct or improve them If corrective exercises are taken they should be under the supervision of a specialist

Good posture The preceding discussion makes it evident that what is meant by good posture cannot be expressed in a single statement Authorities affirm that good posture consists of sitting or standing so as to be as tall as possible They tell us to keep the chin well up and hold the head so as to press the back of the neck against the collar These and other statements are helpful but they are hardly adequate, if one is seeking a satisfactory definition of good posture

When one is standing with feet together, the weight of the body should be centered around imaginary points just a little in front of the ankles, the weight actually being borne by the heel, the ball of the foot, and an area under the big toe The ideal posture is not a rigid one like that of a soldier at attention, whose

chest is high and whose abdomen is markedly drawn in At least such a posture would not be desirable for a person entering a drawing room, addressing an audience or standing under usual conditions Stiffness does not promote poise of body or mind. When standing easily the feet are fairly close together, one foot



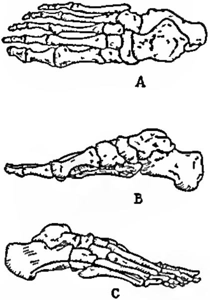
Good and bad positions in bending over and in sitting (Courtesy U S. Department of Agriculture, Miscellaneous Extension Publication No. 34)

being placed a little in front and to the side of the other On the one hand, slouchiness, and on the other, leaning back, should be avoided.

In a sitting position the back should be pressed against the back of the chair If one needs to bend forward, it should be from the hips rather than from the shoulders and when standing one should not attempt to reach the floor by bending from the waist The bending should occur at the hips and knees if the movement is to be graceful and efficient

In walking, the toes should point straight ahead. Habitually

turning the toes outward enlarges the ankles and produces an effect of waddling. Good posture, and grace in sitting and walking, cannot be attained overnight or by giving merely occasional thought to the problems involved, they should be matters of habit which do not require conscious attention. However, to form



The bones of the foot as seen from different positions A overview, B. view of instep, C view of the outside of the foot.

good habits it is often necessary at first to give thought to what one is doing.

The feet and their care. In standing and walking, the feet have to bear the weight of the body Foot troubles of various kinds are one of the most common factors that produce poor posture. The feet are wonderful mechanisms and so constructed that they are able to support and balance the weight of the body. Because of the strain put upon them, and because aching, tired, and malformed feet directly affect the general health of the body, their hygiene is important.

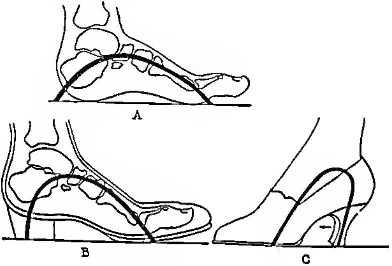
Each foot is composed of twenty six bones arranged in the same general manner as the bones of the hand and wrist There are seven bones composing the heel and ankle, five in the instep, and fourteen in the toes The bones of the instep and heel are held together with ligaments so as to produce an arch Since this runs lengthwise of the foot it is called the *longitudinal arch* The front ends of the bones, which articulate with the toes and which form the longitudinal arch, are held together in such a

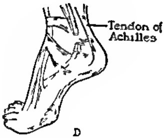
Imprint of different types of feet A normal foot with high arch B normal foot with high arch, C normal foot with low arch D flat foot

way as to form another arch which, because it extends across the foot, is known as the *transverse arch* These arches add greatly to the strength and flexibility of the feet Springiness of step would be impossible without them Witness, for example, the effect of flat feet in which the longitudinal arch either does not exist or has been broken down With flat feet any great amount of walking becomes painful, if not impossible.

Improperly fitting shoes are the greatest single cause of injury to the feet It is particularly necessary for growing children to have well fitting, properly made shoes Everyone should have shoes which are comfortable, with room for the toes to move about and with some support for the instep The heels of shoes should not be more than an inch and a half in height, preferably lower, and should be braced enough to support the heel of the foot They should cover enough surface for their inner edges to

reach a line dropped from the ankle. Callous spots, corns, aching feet, and bunions, which consist of a swelling and inflammation of the first joint of the big toes, may all result from the use of poorly fitting shoes.





The effect of different types of shoes upon the longitudinal arch of the foot and another view showing how the tendon of Achilles may be shortened. A barefoot. B moderate heel. C high heel. D tendon of Achilles.

Many women disregard foot hygiene and in so doing often cause serious injury to their health. They wear shoes with heels that are not only too high but are spiked, that is, have very little supporting surface. High heeled shoes throw the body out of line. The weight is shifted toward the toes and the result is a tendency to break down the transverse arch. Other undesirable

effects follow the habitual use of high heeled shoes The head is thrown too far forward and the tendons of the back of the legs become permanently shortened This results in producing muscle cramp and in making it more or less impossible to wear low-heeled shoes.

Undoubtedly as long as it is fashionable for women to wear high heeled shoes upon certain occasions, they will be worn However, many women wear them most of the time, which is the cause of a large amount of foot trouble If low heeled shoes were worn, except when they would be conspicuous, the amount of harm resulting from the use of high heels would be greatly reduced The injury may be either direct or indirect Foot deformities are a direct result of the habitual wearing of high-heeled shoes. The lowering of vitality is another, but indirect effect, because high heeled shoes make walking and exercising difficult

III EXERCISE

Basic conditions of muscular activity Let us examine in a little detail activities that take place in the body during exercise Exercise requires energy and of course depends upon muscular activity There are certain fundamental conditions necessary for the production of energy Oxidation must occur in the muscles which have to be supplied with both oxygen and fuel for the purpose. The oxygen is supplied by the blood circulating in the muscles. The fuel is a substance called *glycogen*, which is sometimes referred to as animal starch In this form it is stored in the liver, which doles it out to the blood as needed Before it enters the blood it has to be changed to a soluble form called *glucose* As glucose it circulates in the blood, from which it is taken out by the muscle cells as needed Upon entering these cells it is converted back again into glycogen in which form it is oxidized The rate at which oxidation proceeds up to a certain point, is increased as the activity of muscles increases

When oxidation occurs in the muscles, glycogen is converted into carbon dioxide, water, and a substance called lactic acid. The accumulation of lactic acid in the blood is one of the causes of fatigue During the period of rest following severe activity, the amount of lactic acid is gradually reduced, part of it is oxidized to form carbon dioxide and water but the greater part is reconverted into glycogen by the liver.

When the quantity of carbon dioxide in the blood is increased it produces a condition that stimulates the respiratory center in the brain, which controls the rate of breathing, with the result that breathing takes place more rapidly. More oxygen is taken into the lungs, passes into their capillaries and is carried in the blood to the muscles As the store of glycogen is diminished in the muscles by the demands of continued activity in exercise, more of it is drawn from its storehouse in the liver. Carbon dioxide, lactic acid, and some other substances that we have not mentioned, are known as *fatigue substances* because their accumulation in the tissues of the body decreases muscular efficiency, and if exercise is of long duration, brings about exhaustion.

Effects of a normal amount of exercise upon the body. A normal amount of exercise benefits all the systems of the body. The excretory organs, especially the kidneys, which remove many of the waste products from the blood, are stimulated to function more actively. The lungs perform more work, not only in their respiratory function of supplying more oxygen but in their excretory function as well, for practically all of the carbon dioxide which leaves the body is given off from them.

Vigorous exercise, if not too prolonged, increases hunger. Therefore, we tend to eat more and the digestive organs have more work to do Exercise also generates heat that tends to raise the temperature of the body. The heat-regulating mechanism becomes more active and keeps it within a degree or so of the normal temperature. This mechanism, which will be described in some detail later, includes the activity of the sweat glands, of

muscles in the walls of certain blood vessels, and of certain nerves

The heart, like every other organ of the body, grows strong only with use The demands made upon it by muscular activity strengthen it, provided sudden strains are not put upon a heart that is weak from lack of exercise or from illness In fact, the only way that it can meet successfully the unexpected stresses, like prolonged illness and shock that come to everyone at times, is for it to be so strengthened by sane methods of exercise and wholesome living that it will have a reserve strength for emergencies

The muscular system itself is developed by activity The use of muscles in suitable exercise strengthens them, gives them greater powers of endurance and, in young people, promotes their growth Training in the practice of certain movements helps in the co ordination of different sets of muscles Skills of various kinds, in different types of work and in games, depend upon muscular co ordination The gracefulness and effectiveness of well-trained athletes in competitive sports is made possible through a remarkable timing of the alternate contraction and relaxation of muscles

Muscle fatigue You have seen the participants "warming up" at ball games and other athletic contests This helps to prevent too sudden strains which might otherwise injure the muscle fibers Sometimes violent exercise will rupture a muscle, a very painful injury which is called a "charley horse" This damage is much less likely to occur if there is a warming up period

Preliminary activity before contests is desirable also because it takes a certain number of contractions of a muscle for it to reach its highest point of efficiency The presence of a small amount of fatigue substances in muscles apparently stimulates them to contract more effectively However, as muscles continue to be used, the increasing amount of fatigue substances creates a situation in which the muscle fibers gradually lose their power of contraction, finally reaching a point where they do not respond to stimu-

test may be ten times the rate at which oxidation ordinarily occurs in his body The body is a wonderfully flexible machine in the adjustments that it makes to its varying needs for oxidation

Internal secretions in relation to the rate of oxidation There are at least five glands producing hormones, the functioning of which is important in regulating either the availability or the usability of energy producing materials in the body (See page 49) These glands are the pituitary body, whose role in skeletal development has already been discussed, the thyroid, the liver, the adrenals, and the pancreas We have already considered the work of the liver in storing and in doling out the glycogen used by the muscles, but to complete the picture of glandular action in muscular activity something must be said about the functioning of the other glands

The thyroid gland regulates the speed at which bodily activities in general are carried on Its secretion is known as *thyroxin* and is available in medical practice today in the form of thyroid extract The anterior lobe of the pituitary body manufactures a hormone which markedly influences the work of the thyroid gland The pituitary body produces more hormones than any other gland, and since the effects of these secretions are wide spread in the body, this particular gland has come to be known as the 'master gland'

The pancreas produces an internal secretion as well as an important digestive juice The pancreatic hormone, *insulin*, makes it possible for muscle cells to oxidize glycogen When this hormone is lacking glucose accumulates in the blood stream in such quantities that some of it is excreted in the urine Its continual presence in the urine is evidence of *diabetes* This disease may be alleviated by the inoculation of insulin The lives of many people are being prolonged by this treatment which, in most cases, has to be continued throughout life At times sugar appears temporarily in the urine This condition is known as *glycosuria* and may be brought about in several ways, among which is intense emotional excitement

order that it may be produced the body must be supplied with the element, iodine, very minute quantities of which are sufficient for all the needs of the body (See page 38)

Persons suffering from hypothyroidism are lacking in energy An idiotic condition exists in the case of those most markedly affected If this condition is congenital the victims are known as *cretins*, who are stunted in mind and body In certain parts of Switzerland, where the water supply is lacking in salts of iodine, cretinism has been very common If cretins are fed thyroxin early in their lives, they may develop normally If hypothyroidism appears in an extreme form later in life, the individual retrogresses mentally and physically to the level of an idiot This condition is known as *myxedema*

It is possible to measure the metabolic rate of the body When this is done under conditions in which the body is resting it is called a *basal metabolism test* The test is made in the morning before breakfast, for at that time the individual has not eaten for a considerable period and bodily activity is at a low ebb It usually consists in computing the amount of oxygen consumed in a brief period This amount of oxygen is compared with the average amount used by others of the same sex, age, height and weight, under similar conditions based upon data which have been gathered by many tests If the basal metabolism rate is much below normal, prepared thyroxin, or thyroid extract, may be given to increase the rate of oxidation

Thyroxin should not be taken except upon the advice and under the supervision of a doctor, because if used unwisely, it may seriously harm the body It increases the heart rate and speeds up the life processes in general Because its use generally results in decreasing the weight, it has been employed for reducing Some patent medicines for reducing contain the active principle found in thyroxin Anyone who uses them is running a grave risk of bodily injury In some states, thyroid extract can only be obtained upon a doctor's prescription

jurious to his nervous system Exercise for little children should take the form of free play or loosely organized group games

Muscular co-ordination grows with increasing skill in the use of the large muscles, and with added mental capacity The ability to co-ordinate the mental processes influences muscular control markedly The feeble minded and many insane people, lack the power to control their muscles to a greater or less degree and cannot make the finer muscular co ordinations As a rule, physical deterioration accompanies mental deterioration

Because the rest of the body grows faster than the heart until later adolescence endurance contests and severe competitive sports should not be engaged in by boys and girls much before the age of eighteen Also in middle age and later in life, exercise of the more violent types should be avoided

Exercise that is either prolonged or of unusual severity has a definite effect upon the heart It has commonly been thought that the somewhat greater size of the heart of many athletes is a symptom of a form of heart disease, and the term athlete s heart has been applied to it Recent investigations have shown that this idea is erroneous It is now generally agreed that participation in competitive sports by one who is in good health does not leave bad effects, provided the amount of exercise is gradually increased and provided also that it is gradually reduced after the period of training is over A gradual change in the amount of exercise allows the heart to accommodate itself to the differences in the demands made upon it When the demands made by exercise are increased slowly a healthy heart gains the strength to meet the additional strain Statistics on the health and longevity of college athletes appear to indicate that in these respects they have a little advantage over other comparable groups.

Sex Most authorities assert that exercise for boys and girls should be about the same in character and amount until the age of adolescence However most boys before that age are much more active than girls. It is difficult to determine whether this is because they naturally have more energy, or whether it is the

taken into consideration when selecting the amount and types of exercise For example, the periods following meals, when digestive processes are going on, are undesirable times for strenuous activities When we exercise, larger amounts of blood than usual are needed by the muscular system, yet immediately after eating the digestive organs also need more blood than usual in order to function properly The blood cannot adequately meet this double demand made upon it, something has to suffer

Of course, persons who have organic defects of the heart who are suffering from certain other types of defects, or who are recovering from serious illness, either should omit exercise entirely or take only a mild form in limited amounts They should act under the advice of a physician

IV REST AND RELAXATION

Importance of rest Up to this point in this chapter, our interest has been centered chiefly upon the necessity of muscular activity in the maintenance of health It is evident, however from our study of muscle fatigue, that a balanced program of living demands a cessation from activity or rest at certain intervals, if the muscles are to be capable of putting forth a normal amount of energy and if the body is to perform work with efficiency Necessary as activity is, rest is just as important

We have as yet said very little about the role of the nerves in muscular activity, except that they control it Their functioning will be treated in a later chapter However, it is well to observe that since there is a close relationship between the nervous and muscular systems, any factor influencing one will also affect the other Many types of bodily fatigue for example are primarily the result of an overtaxed nervous system rather than of an exhausted muscular system. Thus an individual may be more exhausted by continued worry and excitement, involving very little muscular activity, than by strenuous exercise

tense, can relax by a conscious effort He can think about the particular muscles that are tight and can loosen them Sometimes just relaxing the muscles in the fingers will give a feeling of release from tension When anyone reaches the point where he finds it difficult to relax when he wishes to do so, he may be in danger of experiencing a nervous breakdown from which it may take him a long time to recover

Sleep In the hurry of modern life many people are neglecting to relax They are 'burning the candle at both ends'—over-indulging in activity and reducing the hours of rest and sleep The human organism is made in such a way that it will stand considerable abuse without showing injurious effects, but neglect of the fundamental principles of exercise and rest will sooner or later demand their toll

Since the body usually shows the greatest amount of resilience in youth it is quite natural for young people to think they can safely disregard many of the principles of healthful living They are especially likely to disregard the need of sufficient sleep Many young people, as well as some older ones, make a habit of staying up late at night To do this occasionally involves no great harm, since one almost always manages to catch up soon with an additional amount of rest However, when a person goes for a considerable period with an insufficient amount of sleep, a state of nervous tension is established and he has difficulty in relaxing when he wishes to This condition is harmful in many respects. It renders him unable to work effectively He becomes 'jittery' and irritable Frequently constipation results. These are symptoms of a condition which needs correction as truly as a headache does, or a toothache If it is allowed to continue a vicious cycle is apt to result, in which case worry over work which is not efficiently done prevents one from sleeping and the lack of sleep interferes with good work Maintaining positive health largely depends on a balanced program of work, rest, and recreation, and the ability to relax plays an important role in this program.

In recent years much has been learned about the nature of sleep although authorities still disagree as to just what causes it Some authorities maintain that normal sleep is caused primarily by a decrease in the amount of blood flowing through the brain Others say that it results from changes occurring in the nervous system itself Sleep may be induced normally or it may result from certain diseases injuries, or the use of drugs Whatever its cause may be, it is definitely known that during sleep the tissues of the body recuperate and that any considerable lack of sleep interferes with the efficient functioning of the bodily mechanism

Adults vary somewhat in the amount of sleep needed although the majority need an average of between eight and nine hours Mornings when we awake feeling refreshed have been preceded by nights characterized by a high degree of relaxation One can never, however be thoroughly relaxed in the sense that all activity ceases We continue to breathe while we are asleep, our hearts beat nerves transmit impulses and our skeletal muscles are partially contracted In fact the person who sleeps 'like a log' is not benefited as much as the one who moves around to a considerable extent It has been observed that in normal sleep the position is changed at intervals varying from five to fifteen minutes

It is a rather common experience at times to have some difficulty in dropping off to sleep, especially if one is excited or overstimulated Under these circumstances the brain is more active and the flow of blood to it is increased Since sleep is probably induced at least in part by a diminished circulation in the brain, an effort should be made to increase the flow of blood to other parts of the body Of course, the best plan is to avoid the causes of overstimulation when it is near the time of retiring They are numerous and vary with different people—also at different times with the same people When each one of us has learned the reasons for his own sleeplessness it is only the part of wisdom to regulate his behavior accordingly

There are certain measures that one may take to induce sleep. For instance, a tepid bath just before retiring may have this effect. A glass of hot milk or some other easily digested article of food may help by drawing more blood into the stomach. A brisk walk may accomplish the desired result.

If one is to have a restful night, means must be taken to reduce the number of stimuli that may interfere with sound sleep. A bedroom should be situated in as quiet a place as possible. Window mufflers, which reduce street noises and at the same time permit fresh air to enter the room, are now available. One sleeps more soundly during the second and third hours after dropping off to sleep; toward morning one is more easily awakened by noise, movement, and light. The bed should not be placed so that one faces a window. It is also desirable for a person to have a bed to himself in order not to be disturbed by the movements of another. Temperature has a good deal to do with determining whether one will have a restful night or a disturbed one—not only the temperature of the room, but that surrounding the body. It is not necessary or even desirable to sleep in a very cold room but there should be some movement of air. If there is only one window it may be opened at both top and bottom to create a circulation of air. With two windows good ventilation may be obtained by opening both from the bottom. The temperature of the air surrounding the body may be regulated to a considerable extent by the type and amount of bed clothing. In winter, light weight comforters and blankets of wool are both warmer and more hygienic than heavier cotton covering.

One of the most common causes of difficulty in going to sleep is muscle tension. Without realizing it a person may be in a state of tension when going to bed. The eye muscles may remain tense as well as the muscles of the jaw and other parts of the body. As previously stated, it is possible, by taking conscious thought of definite parts of our bodies, to cause the muscles in those places to lose a great deal of their tension. Many people

find this helpful in inducing sleep In recent years some doctors have specialized in assisting patients to relax In the more severe cases of insomnia a specialist should be consulted for there may be some deep seated physical or mental condition needing expert attention

ment called *mountain sickness* which is commonly suffered when people first go into altitudes much higher than those to which they are accustomed It is due to the difficulty the body has in making adjustments to a reduced amount of oxygen supplied by each breath Usually the trouble disappears after the body has had time to become adjusted to the changed air conditions The high altitudes frequently reached by airplanes make this subject an especially pertinent one

At sea level the oxygen content of the air is about 20 per cent and the carbon dioxide content about 04 per cent Even in the most crowded places outdoors in cities the amount of oxygen is diminished and that of carbon dioxide increased only a few hundredths of one per cent If the amount of oxygen is below 14 per cent, feelings of distress are experienced This low concentration never occurs naturally even in the most crowded places indoors It has been produced in certain controlled experiments where the effects upon the body of diffetent conditions of the air have been tested

It was formerly thought that the most important factor to consider in ventilation was the composition of the air, whether there was sufficient oxygen and not too much carbon dioxide, but experiments have demonstrated that this factor, even when a room is crowded with people, practically always regulates itself The oxygen supply, under even extraordinary conditions of crowding, is practically never sufficiently low to produce any noticeable effects upon the body Of course, if a room were absolutely airtight, the results would be fatal to anyone remaining in it very long However, buildings and rooms are not constructed airtight As the oxygen supply is depleted by breathing, fresh quantities of air from outside are constantly entering, even if the doors and windows are closed There is an exchange of gases through cracks and crevices, like those always around windows and doors and, to some extent, through the walls which are always more or less porous. As the carbon dioxide accumulates, excess amounts of this gas tend to pass out of the room and mingle with the

outside air and fresh supplies of oxygen come in In other words, as a result of diffusion people ordinarily do not suffer, even in crowded places, from either an undersupply of oxygen or too much carbon dioxide

The unpleasant feelings that frequently result from remaining in a crowded room for some time are usually owing to too high temperature, too much moisture in the air, and its stagnation or lack of circulation These conditions tend to derange the functioning of the circulatory system and the heat regulating mechanism of the body

Temperature The heat-regulating mechanism of the body automatically helps it to adjust to variations in temperature At higher temperatures the capillaries near the skin dilate and the blood is drawn to the surface of the body Water and minute amounts of salts, forming perspiration, are constantly being given off from the skin through the sweat glands—and we know that perspiration is increased when we become warm As the perspiration evaporates a cooling effect is produced upon the skin and the blood near it A cooling effect always resulrs from evaporation since heat is absorbed in the process Thus heat is absorbed from the body whenever perspiration evaporates, the more perspiration there is and the more rapidly it evaporates, the more pronounced is this effect In very hot weather when there is danger of prostration or heatstroke it has been found that the excessive loss of salt from the body, incident to the increased amount of perspiration, is an important factor in causing the trouble On excessively hot days it is desirable, therefore, to drink water to which salt has been added The amount recommended is a teaspoonful to one quart of water

In cold weather the capillaries in the skin are constricted, thus conserving the body heat Under such circumstances less blood than usual comes near the surface of the body and the amount of perspiration is reduced The blood is drawn in larger amounts into the internal organs, in this way conserving the bodily heat If it were not for this heat regulating mechanism, our bodies

would not be able to maintain an even temperature of approximately 98 6° F We would develop fevers whenever the temperature of the surrounding air happens to become disagreeably warm or whenever we exercise with any degree of vigor

Since outdoor temperature is an uncontrollable factor in the air, man has had to learn ways of adapting himself to it by wearing clothing suitable to the weather and by building shelters to protect himself against both heat and cold Clothing suitable for warm weather should be of such texture and character that the heat produced by the body may be easily conducted away from it On the other hand, winter clothing should prevent the rapid escape of heat from the body Since air is a poor conductor of heat, wool and fur which enmesh air because of their texture make suitable clothing for cold weather In summer the clothing should be porous and loosely woven Since linen and cotton are good conductors of heat they make good clothing for hot weather

Moisture in the air *Water vapor* is an invisible gas that is always present in the air It comes from the evaporation of water The term *absolute humidity* refers to the amount of water vapor which the air in any locality contains at any particular time *Relative humidity* is the term usually used in weather reports It is applied to the percentage of water vapor present in the air and is computed by comparing the amount that is actually present with the amount that would be present if the air were holding all it could Thus, when we speak of the humidity as being 70 per cent, we mean that the air is holding 70 per cent of the total amount of water vapor it is capable of holding at that particular time

Warm air can hold much more moisture than cold air By lowering the temperature of the air sufficiently it is possible to produce a condensation of water vapor We have all seen the effects of condensation many times The mist which appears upon exhaling in a cold atmosphere is owing to the condensation of some of the water vapor present in the warm air coming from our bodies The droplets of water which appear on the outside of

a glass of ice water are caused by the condensation of water vapor in the warmer air around the glass on its cold surface The formation of fog, clouds, dew, mist, and rain are examples of condensation

The drier the air the more rapid is the evaporation of moisture from our bodies, if the temperature and other conditions remain the same Naturally, higher temperatures cause greater evaporation than lower ones, provided the humidity remains the same On the other hand, the unpleasant sensations experienced on summer days when the humidity is high are owing in part to the lack of evaporation of perspiration The heat of the air has stimulated perspiration but the skin cannot experience the cooling effect of evaporation because the air surrounding it is already near the saturation point, that is, the point at which it is holding all the moisture possible On other days, when the temperature is just as high, or perhaps higher, but the air is not so humid, we may not suffer any great discomfort, largely because during these days evaporation of perspiration can go on more rapidly with the resultant lowering of the surface temperature of the body On a cold damp day it is difficult to keep warm since the body loses heat too rapidly owing to the lower temperature of the air and its high humidity This is because water is a good conductor of heat and the heat given off by the body is conducted away from it too rapidly To counteract this effect we must either become more active, which will result in producing more heat, or we must protect ourselves with "warm" clothing

Motion The movement of the air plays an important role in our health and comfort Stagnant air on a hot day aggravates all of the discomforts of high temperature and high humidity Some movement of air is necessary to remove the "blanket" or "envelope" of air around our bodies and to promote the evaporation of perspiration It is an essential factor in proper ventilation of buildings, as we shall see later in this chapter

Air pollution The air is free from foreign substances in very few places. Pollens and dust particles have been found floating

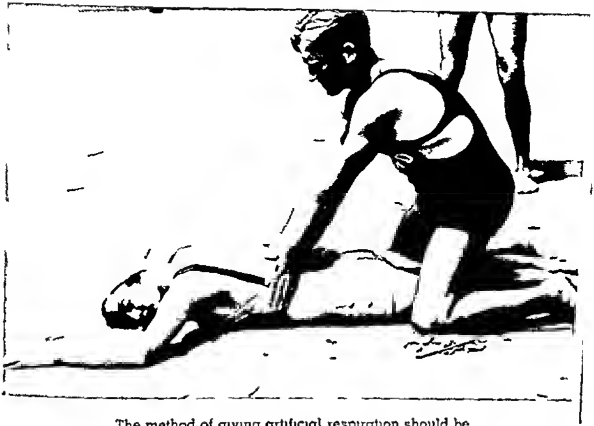
in the air over the oceans many miles from land The dust storms which have arisen from the so called "dust bowl" of the United States have carried dust from the Middle West even to the Atlantic Coast

In general, an ordinary amount of dust particles in the air presents no health problem The dusts resulting from certain industrial processes are a different matter and are the causes of certain recognized diseases, such as silicosis, lead poisoning, and a kind of pneumonia that may result from breathing the dust of hides and animal hairs The prevention of the formation of these dusts or the protection of workers from them are problems for the industrial engineer and the industrial hygienist

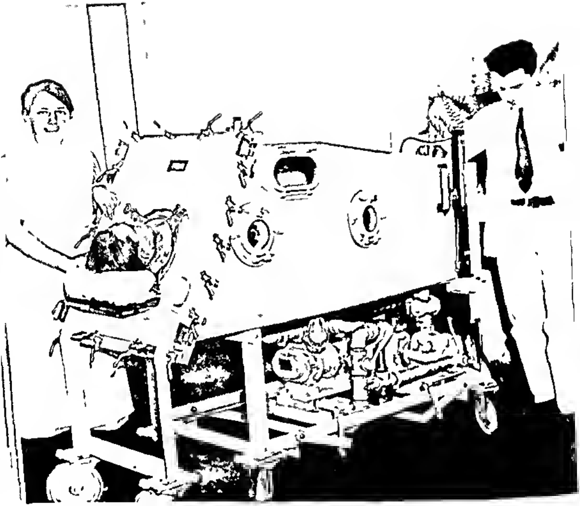
The air of cities is further polluted by smoke which in winter may become so thick as to obscure the sunlight, thus causing injury in two ways The smoke irritates the eyes and the mucous membranes of the respiratory tract and the deficiency in sunlight means a diminished radiation of ultra violet rays This condition is intensified when the humidity is high by a condensation of water vapor on the smoke particles, producing what is sometimes called "smog," or very heavy fog

It has been estimated that about 1 per cent of the population is sensitive to a greater or less extent to pollens of different weeds and grasses These are very widespread in the air from about the middle of May to the middle of September They are the cause of certain types of asthma and hay fever

Disease producing organisms also may be present in the air Since most of them cannot live long outside the body, they do not constitute an important factor in air pollution—with the exception of those types that may be transmitted through the air from one person to another The air exhaled in ordinary breathing by a person suffering from a respiratory disease does not contain disease producing organisms, but if he sneezes or coughs, the air is sprayed by droplets which frequently contain them Even in talking they may be ejected into the air and persons in the



The method of giving artificial respiration should be understood by everyone *(Ewing Galloway)*



The iron lung a mechanical device for giving artificial respiration (*Underwood & Underwood*)

immediate vicinity may acquire the infection if they are in a susceptible condition

Poisonous gases are another source of air pollution Carbon monoxide, which should be clearly distinguished from carbon dioxide presents a serious problem of this type It is caused by incomplete combustion of carbonaceous substances It is the cause of many deaths from leaking gas pipes and from coal stoves with defective drafts It also comes from the exhaust of an automobile when the engine is choked If a considerable number of automobiles are crowded in a limited area such as a city street, carbon monoxide may be present in a high enough concentration at the street level to constitute a menace to bystanders or to officers directing traffic The engines of automobiles should always be turned off in a closed garage or other inclosed place, such as a tunnel when traffic is stopped Many deaths occur every year from carbon monoxide poisoning

Deaths from carbon monoxide poisoning are due to a cutting off of the oxygen supply from the body cells Carbon monoxide enters into a fixed chemical combination with the *hemoglobin* of the red blood corpuscles which normally carry oxygen When this happens they are deprived of their ability to unite with oxygen The body cells actually suffocate in a very short time because countless numbers of red blood cells are incapacitated Carbon monoxide poisoning acts very rapidly practically no warning of its presence being given since the gas is invisible and without odor

Poisonous gases which may be in the atmosphere are of different types and come from different sources, many of them as by products of industrial processes Their degree of danger to public health depends upon their kind concentration and the length of time persons are exposed to them Some kinds, such as ammonia and certain acids, may produce violent irritation of the nose and throat, but not cause severe injury Other types may have little effect upon the upper air passages but may damage the lungs seriously The kind of injury caused by these gases is

vapor doubles about every twenty degrees The problem, therefore, of securing the desirable type of air to breathe indoors is frequently not one of simply letting in and heating the outside air, but of adding moisture to it

In summer air conditioning necessitates doing just the opposite of what is required in winter The temperature of the outside air is apt to be too high for comfort and when it is lowered its relative humidity increases It is necessary under such conditions first to reduce the temperature of the air twenty degrees or so below the desired point and then raise its temperature Reducing the temperature of the air causes a condensation of part of its water vapor content Air in which water vapor is being condensed is saturated with moisture, that is, its relative humidity is 100 per cent, but this same air has a relative humidity of only 50 per cent if its temperature is raised 20° F

Another factor which must be taken into consideration in air conditioning besides temperature and relative humidity is that of air movement It has been estimated that in most rooms of moderate size under ordinary air conditions, even with the windows closed, the air is completely changed once every hour or two The effectiveness of this rate of change will depend upon the temperature of the air, its humidity, the number of persons in the room and their degree of activity Usually the circulation of air is not satisfactory in a closed heated room Windows opened slightly at top and bottom create a draft and may be an adequate way of keeping the air moving if it is too cold outside In the hot days of summer an electric fan is helpful Experiments have shown that air in moderate motion—not enough to make uncomfortable drafts—is a necessary factor in air conditioning

The fourth item in properly conditioning the air is that of cleaning it This may be accomplished by washing or filtering the air or by a combination of the two methods Whatever method is used involves the necessity of employing a fan to move the air There are various mechanisms employed for both washing and filtering air Thus the air may be driven through a shower

or a sheet of water, and there are various other types of filters, both dry and moist

When air in cities is taken from low levels, that is, when it is led through basements or cellars and passed through filters as part of its conditioning, it is amazing to discover the amount of impurities that are ordinarily taken out of it The water through which such air is made to pass for any considerable period of time resembles sewage—and this is the kind of air many people inhale every day! It is not to be wondered at that respiratory disorders are so common Rather does it seem to be remarkable that the respiratory system can stand the amount of abuse which is incident to our modern civilization

The term "effective temperature" means the temperature at which one is comfortable, neither too warm nor too cool, and it includes a combination of the factors conditioning the air, which we have been discussing—that is, air at desirable temperature with proper humidity and movement It varies, of course, with different people, since reactions to cold and heat are affected by age, amount of activity, and acclimatization to weather conditions So much has been learned in just the last few years of methods of conditioning the air that we may look forward hopefully to a time when our indoor atmosphere will be comfortable and healthful during all the seasons of the year at a cost which will not be prohibitive

Especially noteworthy progress is being made in applying air conditioning to various uses in hospitals Periods of convalescence have been shortened and ultra violet ray treatment of air entering operating rooms has resulted in reducing the rate of post-operative infections.

Another more recent field of investigation consists in filtering air by electrical means By making use of such methods it is possible to revitalize the air Thus it may eventually become possible to give to indoor air the invigorating characteristics which we all have experienced at times in outdoor atmosphere

II STRUCTURE AND FUNCTIONING OF THE BREATHING ORGANS

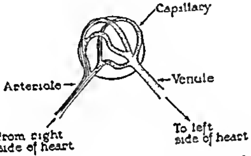
Respiration and breathing *Respiration* in the human organism consists of all the processes by means of which the body cells receive and make use of oxygen, as well as the means by which the carbon dioxide that they produce is eliminated from the body Respiration is necessary for life, and it occurs in all living things, both plants and animals

Breathing is the movement of air in and out of the lungs It is an important part of respiration It is spoken of as *external respiration* to distinguish it from the other parts of the respiratory process which include the transportation of oxygen and carbon dioxide in the blood, oxidation in the cells, and the exchange of gases which is constantly taking place between the blood and the body cells These activities are called *internal respiration*

As we have stated, the inhaled air contains about 20 per cent of oxygen and 04 per cent of carbon dioxide The exhaled air contains about 16 per cent of oxygen and 4 per cent of carbon dioxide The amount of nitrogen present in the air is not changed by breathing It makes up about 79 per cent of the air around us This leaves about 1 per cent of other gases of which argon is present in largest amounts

How does it happen that the amount of oxygen is decreased and the amount of carbon dioxide is increased as a result of breathing? When air is inhaled into the lungs part of its oxygen passes through the thin walls of their capillaries into the blood, where, in the red blood cells, it enters into chemical combination with hemoglobin, producing what is called *oxyhemoglobin*. As the blood circulates through the body, the oxyhemoglobin readily parts with its supply of oxygen to the body cells, the oxygen again passing through the thin membranes of the capillaries which are present in practically all the tissues

At the same time that oxygen enters the blood in the lungs, carbon dioxide passes in the opposite direction, that is, from the blood into the air in the lungs Most of the carbon dioxide present in the exhaled air is formed in the living cells of the body as a result of oxidation occurring in them It passes out from them into the lymph and into the blood stream As the blood circulates through the lungs, the carbon dioxide passes out from capillaries into the air that is exhaled

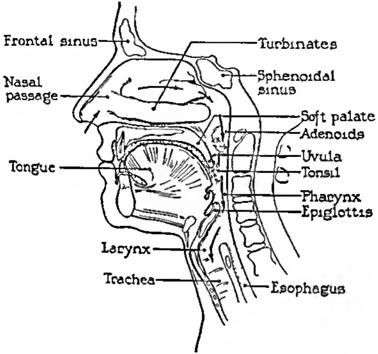


Blood vessels encircling an air sac, or alveolus

Pathways taken by the air on its way to and from the lungs The outside air has free access to the innermost recesses of the lungs through a system of passageways or tubes The air reaches the throat cavity, or *pharynx*, through either the nose or mouth From the pharynx the air passes down through the *trachea*, or windpipe, which is a stiff-walled tube extending through the neck to the thoracic cavity The upper part of this tube is modified into what is called the *larynx*, or voice box The lower part of the trachea divides into two smaller tubes, called *bronchi*, one going to each lung These in turn subdivide into still smaller tubes until finally they become very tiny tubes, the *bronchioles*, which lead directly to the *alveoli*, or air-sacs, the structures in the lungs where the exchange of gases takes place between the blood and the air It is in the walls of these alveoli that the capillaries come close to the air with the result that oxygen is able to enter the blood and carbon dioxide to escape from it

Protective mechanisms in the respiratory tract Has it ever

occurred to you to wonder why the lungs of people who have to breathe a great deal of smoky or dusty air do not become so clogged that they suffocate? This would happen sooner or later to everyone, since we all at times are under the necessity of



Section of the head showing the upper parts of the respiratory tract in relation to adjacent structures

breathing dust laden air, if it were not for certain mechanisms in the upper part of the respiratory tract Moreover, the air is usually not only effectively strained or filtered before it reaches the lungs, it is also humidified and warmed The membranes composing the alveoli and the walls of the bronchioles are exceedingly delicate and would be apt to be damaged, if dry, cold, or dust laden air were to reach them

The hairs in the nostrils catch some of the dust particles, but this is only a minor part of the protective mechanism The

mucous membranes of the nasal passages, mouth, pharynx, and trachea contain cells that secrete a sticky fluid called *mucus* The mucous membranes of the nasal passages act as filters in catching dust particles, and also as a means of warming and humidifying the air By the time the air reaches the back part of the nasal passages, known as the ***nasopharynx***, which constitutes the upper part of the pharynx, most of the dust which it may have contained has been caught by the moist walls of the nasal cavities

Furthermore, some of the cells of the mucous membranes of the nasal passages and the trachea have *cilia*, which are little whip like projections of protoplasm that by lashing movements propel in a definite direction any small particles that may fall upon them These cilia are microscopic but quite effective in moving foreign particles which frequently contain bacteria that might cause serious trouble, if they were to reach the lungs In the trachea these cilia move particles in an upward direction toward the throat and in the nasal passages the cilia produce a backward movement toward the throat Upon reaching the throat the foreign particles along with some mucus are ordinarily swallowed The mucus and the saliva have an antiseptic action

If a person breathes through the mouth instead of the nose, dust particles are more apt to reach the trachea However, they do not usually get into the lungs because the mucous membranes of the trachea tend to catch any foreign particles that may be present in the air around them

Other structures in the respiratory tract or connected with it *Adenoids*, which are masses of tissue in the nasopharynx, may become abnormally large in children, interfering with the passage of air They may have to be removed by a surgeon The *tonsils*, which are located in the throat, are formed of spongy tissue They normally become smaller as one approaches maturity They become easily diseased and afford opportunity for bacteria to multiply in them If a person is troubled with frequent sore throats, or tonsillitis, they may be caused by diseased tonsils

When the tonsils are diseased they may be the means of spreading infection to other parts of the body, or they may cause a general poisoning, or *toxemia* If they are diseased, they should be removed

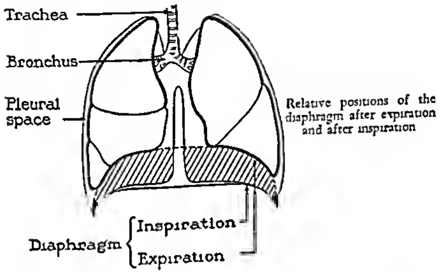
Certain bones in the front part of the skull have cavities which are known as *sinuses* Sinuses, in addition to making the skull lighter, give resonance to the voice They are connected with the nasal passages by means of small tubes and are lined with mucous membranes which are continuous with those of the nasal tracts Hence any inflammation of the nasal membranes may spread to one or more of the sinuses and produce sinusitis

The larynx is a cartilaginous structure which contains the two vocal cords All vocal sounds are dependent upon the passing of air through the larynx and the resulting vibration of the cords The degree of contraction of the muscles which move the cords regulates the pitch of the voice It is usually possible to cultivate a pleasing and effective manner of speaking through training of the vocal cords and speech mechanism In many colleges there are departments of speech and voice clinics where bad habits of speaking may be corrected and good ones established An inflammation of the larynx is known as *laryngitis*

There are two small tubes opening into the nasopharynx and extending to the middle ears upon the proper functioning of which hearing in part depends These passageways, the *Eustachian* tubes permit air to reach the middle ear from the respiratory tract Like the tubes leading to the sinuses they are lined with mucous membranes They often become inflamed when a child has a cold, and may be the means of transferring infection to the middle ear

The mechanics of breathing The breathing movements are usually entirely controlled by the diaphragm and by the muscles between the ribs The diaphragm is a dome shaped muscle which separates the chest cavity from the abdominal cavity (See page 46) When it contracts the chest cavity is enlarged and air is inhaled When it relaxes, the air is exhaled The action of the

diaphragm is practically all that is needed to insure proper breathing of a person at rest However, when more air than usual is needed the contraction of the muscles between the ribs also results in enlarging the chest cavity from side to side and from front to back These *intercostal muscles*, as they are called, are brought noticeably into play during exercise This is because



of increased stimulation from the respiratory center to the muscles controlling breathing (See page 44)

The amount of air taken into the lungs in ordinary breathing is called *tidal air* and it is much less than the total lung capacity In fact, in quiet breathing the amount of air inhaled and exhaled is only enough to fill the upper part of the lungs and the passages leading to and from them One may raise the question as to how sufficient oxygen reaches the alveoli to replenish the supply of the blood and how enough carbon dioxide is expelled to prevent an overaccumulation of that gas in the lungs

Of course, there is no fan in the throat or lungs, the working of which results in producing the breathing movements. Air enters the lungs when the chest cavity is enlarged because there

tends to be a partial vacuum in the lungs, and since there is free access to the air outside some of it is drawn into the body. The lungs cannot move of themselves, but, being composed partly of elastic tissue, they stretch and consequently tend to fill the extra space whenever the chest cavity is expanded

The process of diffusion is constantly operating in the lungs As some of the outside air enters the upper part of the lungs there is a tendency for the oxygen to diffuse or spread out in the direction in which there is less of this gas, and on the other hand, the same tendency applies to the movement of carbon dioxide Hence, there is a movement of oxygen downward into the lungs and of carbon dioxide upward For this reason it is unnecessary to expel all the air from the lungs in order to get an entirely fresh supply with each breath In fact, it is impossible even by the most violent exhalation to expel all the air—there is always a considerable quantity left in the lungs The amount of air which remains in the lungs after the most violent exhalation possible is called the *residual air*

If there were simply a downward pressure in the air about us, our bodies like other structures would cave in from the weight of the air As a matter of fact, there is not just a pressure upon the surface of our bodies but there is a pressure from within outwards which counterbalances the outer pressure This pressure at sea level amounts to aboot 14 7 pounds per square inch The reason why individuals going upward too rapidly, in balloons or airplanes, for instance, experience unpleasant sensations and often bleed at the nose and eyes, is that the pressure from within approximates that of the region from which they have just come whereas the outside pressure has become markedly lower Hence, there is a tendency for the blood to burst its ordinary bounds, especially in the parts of the body where it comes close to the surface

The lungs are slung in a double walled membrane, called the *pleura* The inner wall of the pleura is attached to the lungs and the outer wall is attached to the chest walls and diaphragm

The space between these walls is called the *pleural cavity* The air in the lungs is constantly exerting a pressure upon the inside of the tubes and air sacs which keeps the elastic material of which the lungs are composed pressed against the diaphragm, the chest walls, and the other structures which are present in the chest cavity This is because the pressure inside the lungs is somewhat greater than that in the pleural cavity

In the movements incident to breathing there would be considerable friction between the walls of the pleura if it were not for the fact that they are lined by a membrance which secretes a fluid that acts as a lubricant The walls become inflamed in the disease known as *pleurisy* and may produce either too little or too much of this fluid In either case breathing becomes difficult If there is an excess of this fluid some of it may have to be drained off

If air gets into the pleural cavity a part or all of one lung may collapse depending upon the quantity of air that has entered, since in this case the pressure upon the lung from the outside is increased and becomes greater than the pressure from within Both lungs do not collapse if the surface of one is exposed to the air because the pleural cavity consists of two parts which are separate from each other and surround each of the lungs This collapsing of a part or all of a lung is called *pneumothorax*

Pneumothorax is used in certain cases of tuberculosis A part of one of the lungs is made to collapse by introducing some gas, usually nitrogen, into the pleural cavity at the place where the infection is located This is an efficacious method of treatment because in this manner it is possible to rest the diseased part of the lung which then has a better chance to carry on the fight against the tubercle bacilli

In giving artificial respiration, as in cases of apparent drowning, the body should first be raised to allow the water to leave the lungs Then the patient is placed upon his stomach and pressure is applied to the lower ribs at about four second intervals with the result that air moves in and out of the lungs

III COMMON DISEASES OF THE BREATHING ORGANS

Classifying diseases in relation to the systems of the body. It is not always easy or scientifically correct to classify a disease by the particular system of the body it attacks, since some diseases may attack more than one system and since the effects of most diseases are widespread in the body However, in many instances it is characteristic of diseases to make their initial attack upon the body in a very definite locality as, for example, in the case of diphtheria which starts as an infection in the upper part of the respiratory tract, usually in the throat It is proper to refer to such diseases as disorders of the system first involved In this sense we may designate colds, hay fever, asthma, tuberculosis of the lungs, diphtheria, sinusitis, otitis media, mastoiditis, whooping cough, measles, septic sore throat, pneumonia, and influenza as diseases of the respiratory system

The prevalence of respiratory diseases The above list of respiratory diseases may appear to be rather imposing As a matter of fact, however, it is by no means complete The disorders of the respiratory system rank higher as causes of illness and death than the disorders of any other system The diseases mentioned are among the most common There is a considerable body of important practical information about them that is available to all, and with which it is highly desirable that everyone should have some degree of acquaintance

What the layman should know about disease What type of information would it be well for the average person to possess about these diseases? If we can obtain an answer to this question, it will help us to protect our health not only against these particular disorders, but against others as well We might ask such questions as the following What is the use of my knowing about these disorders? What chance is there that I shall contract one or more of them? If the chance is small, why bother about such information? If the disorder in question is common, is there

anything I can do to avoid getting it? Is there any advantage in being able to recognize its early symptoms? Are there any methods of treatment, which may abort it or lessen its severity if they are applied in the early stages of the disease?

We shall attempt to answer just such questions as these in our discussion of various diseases We shall not mention rare diseases, nor shall we attempt to enter into a full discussion of any disease A detailed study of the processes occurring in the body which is attacked by disease, and the various types of treatment which may be employed in combating different disorders, is the concern of the medical profession and not the layman However, some degree of acquaintance with the work of the medical profession may at times be used by the layman both in the prevention of disease and its alleviation

The common cold Colds constitute the most common ailment to which human beings are subject A conservative estimate of the number of colds contracted by people in the United States every year is 200,000,000 Most people suffer from at least one cold a year and considerable numbers have three or more attacks The amount of money lost by industrial workers and others because of time out or reduced efficiency as a result of colds is very great Furthermore, colds, although not the direct cause of death, result in lowering the vitality and are not infrequently the forerunners of serious diseases such as tuberculosis and pneumonia

Colds are most frequent in the winter months, although they are more or less common throughout the year This is in large measure owing to the fact that we spend more time indoors in places that are frequently overheated, improperly ventilated and unwholesome in other ways, conditions which we have treated earlier in this chapter Closed, crowded rooms facilitate the spread of microorganisms We go outdoors from an overheated room into a much lower temperature, compelling our nasal passages and other parts of our heat regulating mechanism to make a sudden readjustment

Colds are highly contagious during the first three or four days

of their duration If it were possible to isolate sufferers from them during the initial period, epidemics might be stopped rather quickly The practice generally followed by physicians of putting patients to bed, if they have even a slight fever or general malaise accompanying the cold, is not only beneficial but is a method of preventing the spread of the infection Since babies, young children, the aged, and invalids are most susceptible to colds and, since in them these infections are most apt to be followed by more serious illness, the only safe thing to do is to keep them away from persons who have colds A cold in an infant or child is not infrequently followed by bronchitis, which in a considerable percentage of cases is associated with pneumonia It is this latter disease which is most to be feared in both the very young and the very old and is responsible for a great number of deaths every year

A filtrable virus is now generally agreed to be the initial cause of colds, although certain bacteria also are apt to be associated with it, at least in the case of colds which last more than three or four days In the first stage of the cold there is a watery discharge from the nasal passages This is the period in which the filtrable virus is active In the later stages of the cold, if they appear, there is a thick mucous discharge and at this time the associated bacteria seem to be primarily responsible for the condition Most colds run a rather definite course and then disappear, even if nothing is done in an attempt to cure them The danger, however, of simply ignoring a cold is that it is apt to last longer and have complications

precautionary measures a person may take which in the opinion of some authorities prevent catching cold Among these are the avoidance of constipation, fatigue, overeating, and becoming chilled It is a good thing to wash the hands before eating, if for no other reason than because unwashed hands may harbor the germs of colds Individual drinking glasses are desirable, for the common drinking glass may spread the infection

In treating colds rest is always important It is also desirable to remain in an even temperature avoiding sudden changes, especially the chilling of the body, which may be followed by pneumonia When the victim of a cold tries to cure it by taking a patent medicine and shortly afterwards gets well, he is apt to attribute his recovery to the use of the patent medicine although in most cases he would have recovered just as quickly without it There is no scientific evidence to indicate that there are any antiseptics, gargles, nasal drops, or mouth washes that are of any use in preventing colds In fact, their use may result in positive harm in that, although some of them afford temporary relief, they are apt to injure the mucous membranes and make them more sensitive to future attacks of the microorganisms The amount of money spent foolishly in attempting either to prevent or cure colds by using such alleged preventives runs into many millions of dollars annually

The best method of preventing colds is to keep oneself in excellent condition It is generally agreed that clothing should be adequate to protect the body against inclement weather and to insure warmth and comfort Correction of defects of nose and throat, plenty of sleep, exercise in the open, eating foods containing plenty of vitamins like citrous fruits and green vegetables, regular elimination of wastes, and cleanliness foster high resistance to colds and other respiratory infections

Hay fever and asthma Certain types of allergies make their appearance in forms closely resembling colds (See page 73) The most common of these are hay fever and rose colds in which the nasal passages are primarily involved In asthma the sensitivity

is usually evidenced in the linings of the bronchial tubes Pollens, the hairs of animals, feathers, lint, and various foods are capable of producing allergic reactions resembling colds in persons who are hypersensitive to them It is estimated that at least 10 per cent of the population is hypersensitive to one or more types of protein substances although in only about one per cent does it take the form of hay fever The cause of this peculiar sensitivity has not yet been discovered

Skin tests may be made with preparations of these substances, each kind being tested separately After the material is suitably prepared some of it is introduced into a scratch upon the skin If swelling appears, there is evidence of hypersensitivity to that substance However, the absence of a skin reaction does not prove that the person is not allergic to the substance which is being tested

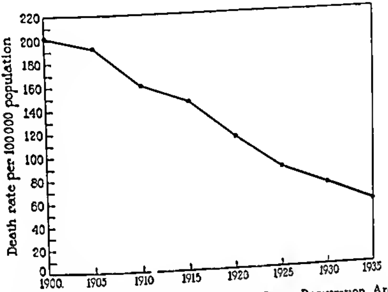
Pollens are the chief causes of hay fever and bronchial asthma The symptoms are produced by proteins in the pollens reacting upon the mucous membranes of the respiratory passages Early in summer the pollens from grasses and trees produce hay fever Later in the summer it is caused by the pollens of certain weeds, such as those of the thistle, pigweed ragweed, and wormweed

Very frequently hay fever and asthma can be cured or relieved by inoculations of solutions of the offending substances Of course one way of preventing or alleviating hay fever and asthma is to avoid the cause of the trouble If it is caused by pollen one may go to a region where the particular offending kind is either entirely lacking, or if present, occurs only in relatively small quantities or he may live and work in rooms where the air has been filtered

Tuberculosis of the lungs Tuberculosis is caused by a bacterium called the tubercle bacillus of which there are four types the human the bovine the avian or bird, and the type which may exist in fish The human type is responsible for over 90 per cent of the cases in human beings It usually enters the body through the respiratory organs Practically all other cases of tuberculosis

in human beings are caused by the bovine type, which may be present in milk or milk products from tubercular cows This type is more prevalent in children

Tubercle bacilli may attack many parts of the body, but most frequently they attack the lungs Tuberculosis of the lungs is com-



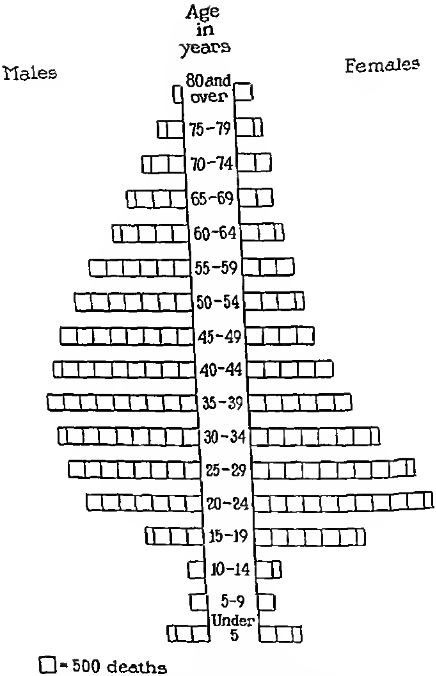
Reduction of deaths from tuberculosis United States Registration Area, 1900-1935 (*From* U S Census Bureau, Mortality Statistics)

monly called consumption At the beginning of the twentieth century tuberculosis was the greatest single cause of death in the United States It is still one of the most common and dreaded diseases, but it now ranks seventh in mortality rates There are several reasons why the incidence of tuberculosis has been reduced Among them are the following a widespread educational campaign regarding the nature of the disease and how to prevent it, improved economic and sanitary conditions, the general pasteurization of milk, increased and improved facilities for taking care of tubercular patients, and improved technique in early diagnosis and treatment of cases

As a part of the educational campaign, attention is being repeatedly called to the fact that sufficient rest, fresh air, nourishing food, and proper exercise help to prevent tuberculosis Milk should be pasteurized to kill any tubercle bacilli that may be present Tuberculosis is an infectious disease, and by far the greatest number of cases are due to contact with persons who are discharging live tubercle bacilli Directions as to the care of tubercular patients in the home have been widely disseminated, such as the need of burning or disinfecting the sputum and disinfecting the various articles handled by the consumptive, especially eating utensils If proper care is taken, the danger of spreading infection is greatly reduced The tubercle bacilli are not apt to be present in the air surrounding a consumptive except when he coughs or sneezes, and there is slight danger for adults in visiting a person sick with this disease

Most people enjoy a considerable degree of immunity against tuberculosis The examination of large numbers of bodies after death reveals the fact that in the majority of people who have reached maturity the lungs have been attacked by tubercle bacilli at some time in the past Yet most of them never knew that they had ever harbored tubercle bacilli *Autopsies*, or examinations of bodies after death, made a few decades ago showed that almost everyone had at some time been attacked by these microorganisms However, autopsies made in recent years show clearly that such attacks are not nearly so prevalent now as formerly There are tests to determine whether a person has tuberculosis or has ever had it Tests of this kind among college students indicate that about 20 per cent have been attacked by this disease

The significance of certain symptoms, a combination of which indicates the probable existence of pulmonary tuberculosis, is generally known These symptoms are weakness or lassitude, loss of weight, a chronic cough, fever, the loss of appetite, night sweats, and the spitting of blood of which the last is the most significant When all these symptoms appear the disease is apt to be well advanced As we have stated, techniques have been developed by



Deaths from tuberculosis according to sex and age, United States Registration Area, 1932.

When active cases are discovered special care and treatment should be given, including an X-ray photograph each year to determine whether the disease has been checked In the treatment of tubercular patients the importance of rest, fresh air, and wholesome food cannot be overemphasized It is stated by competent authorities that if the knowledge we now possess about tuberculosis were applied to its prevention in a thorough manner, the disease could practically be wiped out within a generation

Diphtheria Diphtheria is another disease whose incidence has been greatly reduced in recent years through the application of certain medical discoveries The diphtheria bacilli usually grow upon the mucous lining of the nasal passages, tonsils, or pharynx These bacteria produce a powerful toxin that is absorbed by the blood As in the case of tuberculosis, it is believed that sufficient knowledge about the method of preventing this disease exists to stamp it out entirely (See p 96)

Sinusitis, otitis media, and mastoiditis Sinusitis, as we have previously stated, is the name given to an inflammation of the membranes lining one or more of the sinuses which are located in the forehead directly over the eyes, in the cheek bones and in bones helping to form the base of the skull Generally the ailment disappears after a short time, but a chronic infection may occur which needs medical attention An acute attack of sinusitis is accompanied by headache, more or less fever, fatigue, local pain, and the formation of pus It frequently follows or accompanies a severe cold It is often difficult to treat and in some cases necessitates a surgical operation

Otitis media is the name given to the condition which is characterized by an inflammation of the middle ear It also as a rule originates from a cold The infection is spread from the membrane lining the nasopharynx since it is continuous with the membrane of the Eustachian tubes and the middle ear In children the Eustachian tubes are wider than in older people, and there is, therefore, more likelihood of colds resulting in ear infections The common earache is caused by otitis media It is best to secure

medical attention since a neglected or wrongly treated ear infection may result in mastoiditis, a condition in which there is an inflammation in the mastoid process of the temporal bone The mastoid process is rather porous and, if it becomes diseased, it may be necessary to operate and irrigate it in order to remove the pus which forms when it is inflamed Mastoiditis is one of the most dangerous of the possible complications that may result from colds

Whooping cough and measles Whooping cough and measles in their early stages resemble colds in that they are characterized by nasal discharges, coughing, and slight fever Measles is caused by a specific filtrable virus and whooping cough by a specific bacillus Both of these diseases are especially dangerous to young children and infants Therefore, it is wise to prevent their exposure to them as long as possible Every year in a child's life that these diseases can be postponed results in increasing the chances that relatively slight harm will result from them

Whooping cough and measles are among the most common causes of death in children under five years of age Measles is one of the most contagious of all diseases As we have previously stated whooping cough is especially dangerous in that it is frequently associated with or followed by pneumonia One out of ten babies under one year of age who develop whooping cough succumbs to that infection, whereas during the second year only one in twenty dies

Septic sore throat Septic sore throat is caused by a bacterium, known as the hemolytic streptococcus It usually occurs in epidemic form Its symptoms are an acute sore throat and fever The usual source of infection is from polluted milk which may have been contaminated by a diseased condition in the udders of the cows or from milk handlers who have had the disease It may also be spread from person to person Since milk is the common way in which the disease is spread the safest procedure is to drink only pasteurized milk

Pneumonia Pneumonia is a disease of the lungs which is very serious Roughly one-fourth of all untreated cases of lobar pneumonia result in death It is very prevalent in the United States, the highest peak of prevalence in this country being reached in February and March Pneumonia is more common in the northern than in the southern states, and certain industrial sections of the country show an extremely high prevalence

The disease attacks the lungs and frequently results from a neglected cold When a person who has a cold does not take proper care of himself and foolishly undergoes overexertion or exposure at a time when he should be in bed, pneumonia may develop The third or fourth day of the cold is the most dangerous period

The pneumococcus is the cause of lobar pneumonia in about 96 per cent of the cases The pneumococcus is not a single bacterium, but is made up of a group consisting of some thirty two types Type I and Type II constitute about half the total number of cases A very effective serum has been developed against Type I and Type II lobar pneumonia, and when the serum is given in the early stages of the disease it is very effective in reducing the severity of pneumonia and in preventing death Type III is essentially a disease of elderly people and is highly fatal No serum has been developed as yet for this type Satisfactory sera are becoming available for some of the less common types of lobar pneumonia for example, for Type V, Type VIII, and Type XIV

The diagnosis of the type of lobar pneumonia is quite simple A small specimen of sputum is obtained from the patient and, by

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employing a simple technique, the bacteriologist can determine almost immediately and with a very high degree of accuracy the type of the pneumococcus that is causing pneumonia The proper serum can then be selected and given immediately with strikingly beneficial results

There is a real hope that it may be possible to produce immunity against pneumonia, particularly against the more important and fatal types The experiments by the federal government in immunization of very large numbers of young men in the Civilian Conservation Corps give promise that pneumonia may be prevented by a single injection of the extract of the capsule of various types of pneumococcus This method will be useful in preventing pneumonia in especially susceptible groups, such as its prevention during an epidemic of influenza and during the mobilization of troops in time of war

Influenza Influenza, like colds and measles, is caused by a filtrable virus It is apt to appear in epidemics of varying degrees of severity It is most common in the late winter and early spring At the present time there is no method of immunization although some research workers in this field are hopeful that a vaccine may be prepared in the near future Up to the present, however, health officials are no better prepared to fight an epidemic of this disease than they were in 1918 when it appeared in its worst form At that time theaters and many other places where people congregated were closed for protracted periods in many communities Authorities affirm that the closing of schools is ineffective in checking an epidemic of influenza There is reason to believe that it may be a matter of individual susceptibility or immunity which determines whether any particular person will contract this disease when it appears in its violent form The great danger in influenza is that of the possibility of its being associated with pneumonia A person suffering from influenza should remain in bed until the period in which complications are apt to arise has passed

VI

THE FOODS WE EAT

1 THE RISE OF THE SCIENCE OF NUTRITION

The purposes of food. Food is one of the basic physical needs of the human body. It serves two major purposes: (1) it is the source of all bodily energy, and (2) it is used for the growth of tissues and for repair of those that are broken down in bodily activity. Most foods are of no value for either purpose until they have undergone certain mechanical and chemical changes in the body. These changes are known as *digestion*. The digestive processes transform the constituents of foods into products that fulfill these special uses in the body.

Foods are of two kinds, organic and inorganic. The inorganic foods are water and minerals. The organic foods are derived from living organisms. Whatever is their immediate source, they all contain carbon which green plants extract from the carbon dioxide of the air in the process of photosynthesis. (See page 27.) These carbon compounds are the chief fuel substance of the body, being oxidized in the cells. They are, therefore, the principal source of bodily energy.

The energy in food. The energy locked up in food is known as *potential*, or latent, energy. This energy can perform work only when it is released. It is liberated in the body in oxidation, becoming *kinetic* energy, or the energy of motion. This is the energy which enables the body to carry on all its metabolic processes and to perform all its varied activities.

When foods are burned or oxidized outside the body they give off an amount of heat that may be measured. When they are completely burned in the body they produce the same amount of heat. This is what is meant by the fuel or energy value of

foods The unit of measure for heat is the *calorie* As the term is generally used with reference to foods, it means the amount of heat required to raise the temperature of a kilogram of water one degree C A calorie should be distinguished from a degree It refers to the amount of heat whereas the degree is used in the measurement of temperature

The science of nutrition Until the knowledge gained by a study of the chemistry of the human body showed how the constituents of foods met its needs for energy and the building up of tissues, there could be no real scientific basis for an adequate diet Eating was a more or less haphazard affair, controlled by the appetite and the experience of what had proved safe and satisfying Science now teaches us that the appetite is not always to be trusted in the selection of foods and can be used as a guide only when regulated by knowledge

Biochemists now know that the protoplasm of the cells of the human body contains at least eighteen of the known chemical elements although its exact composition has not been learned It is known also that foods contain these elements The chemical organization of the body cells is being continuously changed in the course of their functioning The elements of which they are composed are constantly being more or less depleted as a result of body activities For instance, we have already discussed how glycogen, the fuel substance present in the muscles and stored in the liver, is oxidized in muscular activity Food supplies the tissues with the elements of which they are constantly being depleted and with the materials to meet the energy requirements These are the nutritive needs of the body However, it can readily be seen that these needs vary with many factors like the amount of muscular activity, rapidity of growth, age, and physical condition The growth requirements of children and young people, for example, make nutrition demands that adults do not need to take into consideration

There is today a well established fund of knowledge about how the body utilizes food and what foods it needs to maintain

a chemical balance between income and outgo This information has been gathered by innumerable laborious and painstaking experiments over a period of more than a century In fact, Lavoisier (1743-1794), the father of modern chemistry, initiated our knowledge of a basic use of food in the body with his discovery that it is utilized as fuel in the process of oxidation This body of information about diet has been organized into a well defined science, the *science of nutrition* In spite of the many gaps in our knowledge of the effects of foods on the human body, we now have sufficient data to enable us to know what to eat and how much to eat, with considerable assurance as to what the effects will be on our health and supply of energy In other words, we now know what constitutes an adequate diet to meet the needs of different groups of people in all stages of their growth and activity

The basic food substances Before the middle of the nineteenth century chemical analysis of the tissues of both plants and animals had disclosed that they were composed of five substances carbohydrates, fats, proteins, mineral salts, and water These substances were regarded as the basic food substances, or *nutrients*, in the diet of all animals It was determined that there are many different combinations of organic nutrients—the carbohydrates, fats, and proteins—in the different foods or in the same food, but that the different members of each group are similar in their behavior in the body Each group performs its own services in the body metabolism

The chemical composition of various foods was studied in order to find in what proportion the different nutrients are present in them Most foods were found to contain two or more nutrients, but in widely different proportions. One method of classification is to group them according to the organic nutrient present in the largest concentration For instance, meats are called protein foods because, as a group, they contain more protein than any other organic nutrient

Until the last few decades physiologists considered a diet ade-

PERCENTAGES OF ORGANIC NUTRIENTS IN SOME COMMON FOODS [1]

	% Proteins	*% Carbohydrates*	*% Fats*
Dairy Products			
butter	1	—	85
cheese, American	28.6	3	36
cream, thin	2.6	4.6	18.5
cream, heavy	2	3.3	40
milk, whole	3.3	5	4
egg	13.4	—	10.6
Fish			
cod, fresh	18.7	—	.5
cod, dried	9.9	5.5	10.7
salmon, fresh	22	—	12.8
oysters	6.2	3.7	1.2
Fruits			
apples	.4	14.2	.5
banana	1.3	22	.6
orange	.9	10.9	.2
peach	.5	12	.1
prunes, dried, unsweetened	2.2	73.2	—
Meats			
beef, sirloin	18.9	—	18.6
chicken	26.2	—	10.4
lamb chop, broiled	21.8	—	30
ham, smoked, lean	19.8	—	20.8
pork chop, lean	20.3	—	19
bacon, cooked	23	—	66
Nuts			
almonds	21	17	55
peanuts	26	25	39
pecans	9	15	70
Sugars			
molasses	2	70	—
sugar, white	—	100	—
Vegetables			
beans, string	2.3	7.4	.3
cabbage, cooked	1.6	5.6	.3
lettuce, iceberg	1.2	2.6	.4
peas, canned	3	8.2	.2
peas, fresh	7	16.9	.5
potato, sweet	1.8	27.4	.7
potato, white	2.2	18.4	.1
spinach	2.1	3.2	.3
tomatoes	1.2	3.5	.2

[1] Adapted from *Food Values of Portions Commonly Served*, compiled by Anna D. Bowes and Charles F. Church, copyrighted 1937 by the authors. Note: the dash does not indicate that the substance is entirely lacking but rather that it is present in so small a quantity as to be negligible.

quate for growth and health if it contained sufficient calories and all of the nutrients in what seemed to be the correct proportions One protein food was apparently as good as another protein food, regardless of its source The proteins of peas and beans, vegetables rich in this nutrient, were considered as being identical, with reference to their uses in the body, with those of milk and meat, and the fats of lard and butter were believed to produce a similar effect Later experiments show the fallacy of these conclusions It has been discovered that proteins vary greatly in their value, in fact, that certain proteins are indispensable to growth and health, and that serious consequences result from their lack in the diet Experiments have also demonstrated that butter fat contains some essential elements that are lacking in lard

The discovery of vitamins The discovery of the sixth nutritive factor, determined about 1913, accounted for the inadequacy of diets which previously had been considered "satisfactory" Experimentation carried on at that time indicated that in certain foods, such as cow's milk and butter fat, there were some substances present that could not be determined by chemical analysis, and yet they had significant effects on growth and the maintenance of health

A Polish chemist, Funk, used the word "vitamine" in 1910 to indicate that there are indispensable factors in some foods that are essential to good health He believed that the deficiency diseases, pellagra, scurvy, rickets, and beriberi, were all caused by the lack of certain nutritive substances, or "vitamines," in the diet However, these factors were not really discovered at that time, for he knew little more about their nature than that they exerted some preventive action

Previous to this time it had been learned that scurvy, a disease which appeared among groups of people, like sailors, who were fed stale foods over a long period of time, would be cured if fresh fruits and vegetables were given in the early stages of the disease It was also learned that ship scurvy could be prevented

by giving the men a small but frequent ration of fruit juice Likewise, it had been found that beriberi was caused by a diet deficient in certain food elements A ship in the Japanese navy took an extended cruise during which cases of beriberi occurred among the sailors, the diets of these men were carefully studied A second ship made the identical cruise, but the sailors were given a much more varied diet The results of the second cruise conclusively demonstrated that a faulty diet was responsible for the disease

Extensive experiments have been carried on ever since it was first determined that there were certain substances in foods that defied chemical analysis These experiments have brought to light many of the significant effects on health and life itself of these substances now called *vitamins* At least six have been discovered, A, B, C, D, E, and G, the last one, vitamin G, in 1929 B has been subdivided into four or five elements, and it is probable that further research will disclose that each of the vitamins is a complex substance made up of a group of essential food constituents A few of the vitamins have now been chemically identified, and actually synthesized

II THE NATURE OF FOODS AND THEIR USES IN THE BODY

The nutrients The *carbohydrates* consist of two chief classes of foods, *starches* and *sugars* They are the chief source of fuel for the body and make up the bulk of the diet of a large percentage of people

Carbon is the basic element enteriog into their chemical composition Although carbohydrates are found to some extent in foods of animal origin, plants are their major source Many of them contain *cellulose,* the connective tissue of plants, which is valuable in furnishing bolk or roughage in the diet but has no food value to man Our chief sources of starch are cereal and root and seed vegetables The foods containing the greatest

amounts of sugar are fruits, sugar cane, honey, and certain tuberous vegetables, like beets and carrots

The digestion of sugar is more rapid than that of starch and therefore is a more immediate source of energy Its rapid absorption by the tissues is the reason that soldiers on a forced march are sometimes supplied with chocolate candy The digestion of starches is slower, and, for this reason, they form a steadier supply of fuel Starches are changed into sugars during the process of digestion When carbohydrates are oxidized, carbon dioxide and water are the end products, but the rate of their oxidation depends upon the activity of the body (See page 1-) When more carbohydrate material is eaten than is needed for energy, the excess may be built up into fat and stored in this form The stored fat is then drawn on when the supply of carbohydrates is deficient.

Starchy foods, like bread, other cereal foods, and potatoes, are the most economical source of the body's supply of energy They are more abundant, satisfy hunger for a longer period of time and have better keeping qualities than most other classes of foods For these reasons they form a large percentage of the diet, but, unfortunately, too large a percentage among low-income groups of people all over the world who live almost exclusively upon starchy foods Very few of them are complete foods, that is, contain all of the essential proteins, vitamins, and minerals, therefore, starchy foods need to be supplemented by foods that have the nutrients in which they are deficient

Fats are also used for the production of energy, of which they yield about twice as much per unit of weight as carbohydrates. They are not, however, so easily digested and should not be eaten in such large quantities. Not only are they a source of readily available energy like carbohydrates, but they are stored in the body when not needed for immediate use. Fatty tissues serve as a protection to the vital organs, forming around them and under the skin. This fatty tissue is called *adipose tissue* The

adipose tissue under the skin acts as a blanket which prevents too rapid radiation of the body heat

Proteins are used for growth and repair of tissues as well as for energy production They are of equal energy value to carbohydrates All protoplasm contains protein and hence it is present in all organic foods to a greater or less extent Protein foods are relatively more expensive than carbohydrates They are, however, absolutely essential to life, because they are the only source of nitrogen in such form that the body can use it Nitrogen compounds are indispensable in the structure of protoplasm Besides nitrogen, proteins contain oxygen, hydrogen, and carbon, and many contain sulphur They are chemically very complex and the elements forming them are combined into many different compounds

Proteins must be broken down in the process of digestion into simpler compounds, called *amino acids*, in order to be utilized by the body These appear in different combinations making up the many varieties of proteins At least twenty-one amino acids are known, some of which are indispensable to the human body The proteins containing essential amino acids are called "complete" They are not present in the proteins of all foods but come largely from animal sources A lack of them in the diet results in serious nutritional disturbances Milk, eggs, fish, fowl, lean meat, liver, and kidneys are sources of complete animal proteins. Wheat, corn, and nuts are sources of complete vegetable proteins which, however, would have to be eaten in very large quantities to provide a sufficient amount of the indispensable amino acids in the diet

Minerals When the human body is burned as in cremation or in slow oxidation after death, it is not totally consumed There is always an ash This is made up of the mineral salts that enter into its chemical composition and constitute about 4 per cent of the body weight They are present in all tissues but in the greatest amounts in the bony structures Most of them are essential to body metabolism, although their uses are not all clearly

understood They must be supplied in our foods in order to replenish the losses which occur in the katabolic changes in the body

The elements present in the mineral salts are phosphorus, sulphur, potassium, sodium, chlorine, iron, magnesium, calcium, iodine, copper, manganese, zinc, fluorine, and silicon

Sodium is found in the body chiefly in combination with *chlorine*, as sodium chloride Common table salt is sodium chloride It is so important to the body that it must be added to food in a diet that is naturally deficient in it People who live principally upon a vegetarian diet have a craving for salt, because the potassium concentration in vegetables and fruits reacts with sodium chloride to form compounds that are quickly eliminated by the kidneys A diet which contains a large proportion of meat requires the addition of very little salt. Sodium chloride is needed in the blood and plays an important role in osmosis

Potassium is a necessary constituent of the cells of the body As we have indicated, it is present in vegetables and fruits It is found also in whole grains and seeds It is so widespread in foods of plant origin that it is practically always present in our diet.

Calcium is essential in the functioning of the body (See page 109) It has some effect upon the ability of the blood to clot and muscles to contract It is an essential constituent of both bones and soft tissue If the necessary amount is not present in the diet every day, the deficiency will be made up by extracting it from the bones and teeth It is more apt to be lacking in the body than any other element Milk is the best source of calcium, an adequate reason in itself why both children and adults should have milk or milk products in the daily diet

Iodine in small quantities is essential to the production of thyroxin, the secretion of the thyroid gland When it is markedly deficient or lacking in the diet, goiter is apt to result (See page 38) Iodine is present in vegetables which are grown in soil where it is present and in milk from cows whose food contains it It is also found in sea foods.

Phosphorus is also a required element in the daily diet It enters into the composition of all the different cells of the body A mixed diet supplemented with milk will furnish the body requirements for both calcium and phosphorus

Iron is an essential component of the hemoglobin, the constituent of the blood which carries oxygen and is a necessary part of the body cells (See page 146) Normally a person has an amount of iron in his body that equals the weight of a penny, or a little less than one tenth of an ounce Because of the vital importance of hemoglobin as the carrier of oxygen to the body cells, iron plays an essential role in metabolism Five ten thousandths of an ounce should be supplied daily Liver, kidney, and brains contain large amounts of iron as compared with most other foods It is also found in some fruits, egg yolks, green leafy vegetables, dried beans and peas, oysters, shrimps, and meat A variety of iron containing foods should be eaten every day, since to get the desired amount from spinach, for example, one would have to eat two and one half cups, or consume more than a pound of meat or about a dozen egg yolks

Sulphur is an essential constituent of many proteins and is always present in a diet containing an adequate amount of this nutrient *Copper* and *manganese* are found in hemoglobin It has been found that copper is necessary to its functioning as oxygen carrier, and it is believed manganese is also *Magnesium* is an essential constituent of the bones

The functions of *zinc*, *fluorine*, and *silicon* in the body are not known It is possible that they are there only because they are present in foods

Definite provision should be made to select foods that contain iodine, calcium, phosphorus, and iron In making provision for the inclusion of these minerals in the diet, the other essential minerals will be supplied since they appear in foods in combination with them

Water Water makes up about two thirds of the weight of the body The fluid part of the blood is over 90 per cent water, and

SOME FOODS CONTAINING MINERALS[2]

KEY

X—in small quantity
XX—in average quantity
XXX—an excellent source

	Calcium	*Phosphorus*	*Iron*
CEREALS			
cornmeal	—	X	X
oats	X	X	X
wheat whole grain	X	XX	XX
DAIRY PRODUCTS			
cheese American	XXX	XXX	X
cream 18.5% fat	XX	X	X
milk whole	XXX	XXX	X
eggs	XX	XXX	XXX
FRUITS			
apricots dried	X	X	XXX
banana	X	X	X
blackberries	X	X	X
cherries	X	X	X
dates	X	X	XXX
figs dried	XX	X	XXX
grapefruit	X	X	X
oranges	X	X	X
peaches dried	XX	X	XXX
prunes dried	XX	X	XXX
raisins dried	XX	X	XXX
strawberries	X	X	X
MEATS AND FISH			
kidney	—	XXX	XXX
liver	—	XXX	XXX
meats with more than 12% protein	—	XXX	XXX
fish	XX	XXX	X
oysters	XX	XXX	XXX
shrimp	XX	XXX	XXX
NUTS			
almonds	XX	XX	XXX
peanuts	X	XX	XX
pecans	X	XX	XXX
walnuts	X	XX	XXX
SUGARS			
maple syrup	X	—	XX
molasses	XX	—	XXX

[2] Adapted from *Food Values of Portions Commonly Served*, compiled by Anna D Bowes and Charles F Church copyrighted 1937 by the authors, and from bulletins of U S. Department of Agriculture The dash indicates that the substance is lacking or present in negligible quantity

	Calcium	*Phosphorus*	*Iron*
VEGETABLES			
beans lima dried	X	XX	XXX
beans string	XX	X	XX
beans navy	X	XX	XXX
beet greens	XX	X	XX
broccoli	XXX	XX	XX
cabbage	XX	X	X
carrots	XX	X	X
cauliflower	XXX	XX	X
celery	XX	XX	X
dandelion greens	XXX	XX	XXX
lettuce	XX	XX	X
mustard greens	XXX	XX	XXX
potatoes white	X	XX	X
peas	XX	XXX	XXX
spinach	XX	XX	XXX
turnip greens	XXX	X	XXX

the brain is 70 to 85 per cent water It is always present in living cells and is essential in many of the processes taking place in the body—for example it is indispensable in the process of digestion Protoplasm dies if it becomes thoroughly dry Osmosis cannot occur through membranes that are not moist, and since osmosis is vital to the giving off of wastes from cells as well as to their acquiring nourishing materials the important role taken by water in life activities is evident Water formed as a result of the combustion of fuel foods is constantly being given off from the body in perspiration, in water vapor from the lungs, and in urine excreted by the kidneys This is known as metabolic water The reason that some animals do not drink water at all or can go long periods without it is that their metabolic water is sufficient to meet their needs In severe exercise a man may in a very short time lose several pounds of water through perspiration To counterbalance this loss it is important to drink sufficient water Of course, practically all of our foods contain water and we get it in our beverages but in addition to this most people should drink from six to eight glasses of water a day, at least

Vitamins Vitamins A, B, C, D, and G have become of great interest and importance because of the occurrence of certain

specific diseases when these elements are lacking in the diet, and also because we are just beginning to learn that relatively slight deficiency of the vitamins in the diet may prove to be a serious handicap to the normal growth and development of children Each of these vitamins performs specific functions in the protection of the body and in the promotion of tissue growth When any of them is not present in the diet in adequate amounts, incipient symptoms of the specific diseases become evident, and changes occur in the tissues which weaken the body and produce vague symptoms in a wide variety Collectively the vitamins together with the essential minerals and amino acids are absolutely necessary for normal growth and for the maintenance of general health and vigor Every individual's diet should be so planned as to include all of these, but it is particularly necessary for children to eat foods that are rich in them in order to insure optimum growth and vigor

Authorities generally agree that optimal amounts of vitamins in the diet are much greater than the intake considered necessary actually to prevent the symptoms of deficiency It is fortunate that we who live in the United States have a large supply of available foods that are rich in vitamins Unless there is some pathological condition interfering with normal digestion, we should get vitamins naturally through the foods we eat just as we do the other nutrients The essential factors of a well balanced vitamin dietary are plenty of milk, fresh fruit, and fresh vegetables There is no reason for the normal, healthy person to take vitamin concentrates or prepared vitamin products. If used at all, they should be taken under the advice and direction of a physician

Vitamin A prevents *xerophthalmia*, a disease of the eyes. Night blindness is one of the early symptoms of vitamin A deficiency It is a condition in which there is difficulty or inability to see in a dim light Varying degrees of nutritional night blindness are caused by relative shortages of vitamin A in the diet. Investigations among groups of school children and adults have revealed

previously unsuspected cases of night blindness, many of which were cured by giving foods containing vitamin A Many otherwise normal people who have trouble in automobile driving at night are suffering from a mild degree of vitamin A deficiency Their eyes do not adjust quickly to dim light after being exposed to the glare of automobile headlights

Vitamin A is of help in building up a general resistance to infections which may occur when the supply in the diet has been inadequate Some authorities believe it may be of help in establishing a resistance to respiratory diseases The latter, it has been discovered, are frequently associated with cases of night blindness in children Vitamin A is valuable in promoting normal growth, so that large amounts should be supplied to pregnant women and nursing mothers

Vitamin A is soluble in fats but is not easily soluble in water It is not readily destroyed by heat, and ordinary baking and boiling temperatures do not affect it Though it can be stored in the body, it should always be part of the daily diet of children to safeguard their growth needs in addition to insuring normal functioning of the eyes It is found abundantly in butter, cream, egg yolk, and yellow root vegetables, such as carrots

Vitamin B is called the antineuritic vitamin to indicate that it prevents certain nervous disorders A marked deficiency of it causes beriberi, a disease present in areas in the Orient where the people live principally on polished rice Use of the whole grain will prevent this disease In incipient form beriberi may be found among all groups of people whose diet contains too large a proportion of over refined foods, such as bakery products and breads made of white flour, and when it is lacking in mill , eggs, fruits, and vegetables The refining processes remove a large amount of the vitamin B found naturally in the germ portion of the seeds, like wheat, rye, and oats

Insufficient amounts of vitamin B result in poor appetite and malnutrition in children It is essential to growth and to one's general health at all ages An infantile type of beriberi develops

in nursing infants whose mothers do not have enough of this vitamin in their diet

Vitamin B is easily soluble in water but is more stable in acid foods It is destroyed by heat only after long cooking Soda should not be added to the cooking water

Vitamin C is the "antiscorbutic vitamin," that is, the vitamin that prevents scurvy When it is markedly deficient or lacking in the diet such symptoms as the following may appear hemorrhages, particularly under the skin and the periosteum, sallow complexion, lack of energy, swollen gums, and a loosening and falling out of the teeth These are the characteristics of scurvy and are present in a less degree in incipient cases when the dietary has a relative shortage of the vitamin Vitamin C, extremely important in normal nutrition, should be present in adequate amounts in every person's diet regardless of his age.

Vitamin C readily dissolves in water and is lost if the water used in cooking is discarded It is easily destroyed by heat and by boiling, especially when exposed to the air, and in an alkaline medium by the addition of soda Because tomatoes are especially rich in vitamin C and are very acid, this vitamin is not entirely lost in the canning process Baked potatoes also contain it because it is preserved by the potato skin Milk is poor in vitamin C, and whatever amount may be present is largely lost in pasteurization Since a daily supply of vitamin C is essential, it follows that orange juice or tomato juice should be added to the diet of babies Its best sources in the diet are raw fruits and vegetables, particularly the citrus fruits. This vitamin is so easily destroyed that orange juice, if left standing in the ice box over night, loses most of its vitamin C content.

Vitamin D is known as the "antirachitic vitamin" because it prevents rickets. Rickets causes abnormalities of the skeletal development (See page 30) The rachitic infant develops such symptoms as restlessness, constipation, and anemia. If vitamin D is markedly deficient, the child is apt to be bow-legged, flatchested, to have poor posture and to be slow in development.

Vitamin D helps to control the utilization of calcium and phosphorus in the body, which, as we have seen, are essential in the development of the bones and teeth Although it does not insure normal structure of the teeth and it is not certain to prevent tooth decay, on the other hand, it is probable that the development and maintenance of sound teeth are dependent upon an adequate amount of vitamin D in infancy and early childhood Pregnant women and nursing mothers require an abundance of vitamin D for aid in the growth of the baby as well as to protect the woman's own teeth from rapid decay

Exposure to sunlight stimulates the development of vitamin D by means of the action of the ultra-violet rays on the ergosterol in the skin (See page 30) It may be increased by irradiation with ultra violet rays in the foods which contain ergosterol, or irradiated ergosterol may be added to foods to supply them with vitamin D The ordinary foods, excepting butter and egg yolk, are very poor or deficient in it For this reason during the winter months in temperate and arctic zones the diets of infants and young children should be supplemented with cod liver oil, halibut liver oil, or viosterol, a substance made from an irradiated ergosterol preparation These fish oils are also rich in vitamin A However, administering vitamin D in this way does not wholly take the place of exposure to sunshine and does not offer all of its beneficial effects Vitamin D is not destroyed by cooking and it can be stored in the body

Vitamin E is the "antisterility vitamin" It was discovered by experimentation with rats which became sterile when deprived of it in their diet. It is so widespread in food that its lack is not believed to be responsible for sterility in human beings It is not destroyed at ordinary cooking temperatures

Vitamin G, which is associated with vitamin B and sometimes referred to as B_2, has been used by many authorities to designate that factor in foods which prevents the disease called *pellagra* Other authorities separate the pellagra preventing factor from vitamin G Pellagra is characterized by pigmentation or bronz-

ing of the skin on the wrists and neck, sore mouth, diarrhea, weakness, and mental disturbances Among the best sources of the pellagra preventing factor are brewer s yeast, lean beef, liver, fresh peas, turnip greens, milk, and tomato juice Pellagra is frequently found among the inmates of institutions where the supply of food is restricted and in the families of underprivileged groups It is present in Europe and Asia as well as in the southern section of the United States among groups of Negroes and poor whites

Vitamin G is called the poor man s vitamin' because it is frequently lacking in the diets of the low income groups all over the world, since its best sources are among the more expensive foods--eggs, milk, and lean meats Relative shortages of it cause loss of weight and appetite, weakness, arrest of growth, digestive disturbances, and nervous depression

SOME FOODS CONTAINING VITAMINS[8]

KEY

\\—small quantity
\\\\—a good source
\\\\\\—an excellent source

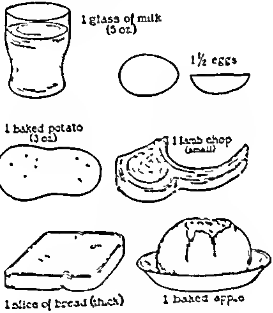
	A	B	C	D	G
CEREALS					
cornmeal yellow	\\\\	\\\\	—	—	—
wheat, germ	—	\\\\	—	—	\\\\\\
DAIRY PRODUCTS					
butter	\\\\\\	—	—	\\\\	—
cheese American	\\\\\\	—	—	—	\\\\\\
cream thin	\\\\	—	—	\\	—
milk whole	\\\\	\\\\	—	\\	\\\\\\
egg	\\\\\\	\\\\	—	\\\\	\\\\\\
FISH AND MEATS					
oysters	\\\\	\\\\	—	\\	—
salmon canned	\\\\\\	—	—	\\\\\\	—
kidney	\\\\	\\\\	\\\\	—	\\\\\\
liver	\\\\\\	\\\\	\\\\\\	\\	\\\\\\
meat, lean	—	\\\\	—	—	\\\\\\

[8] Adapted from *Food Values of Portions Commonly Served* compiled by Anna D Bowes and Charles F Church copyrighted 1937 *by the authors,* and from bulletins of U S Department of Agriculture The dash indicates that the substance is lacking or present in negligible quantity

	A	*B*	*C*	*D*	*G*
Fruits					
apples	X	X	XX	—	X
banana	XX	X	X	—	X
blackberries	XX	X	—	—	—
cantaloupe	XX	X	XX	—	—
cherries	XX	X	X	—	—
dates	X	X	—	—	—
figs, dried	X	X	—	—	X
grapefruit	—	X	XXX	—	XX
grapes	X	X	—	—	—
lemon	X	X	XXX	—	X
orange	X	XX	XX	—	X
peach	XXX	X	X	—	—
pear	—	X	X	—	XX
pineapple, fresh	X	XX	X	—	X
prunes, dried	X	X	—	—	XXX
strawberries	X	X	XX	—	—
watermelon	X	X	X	—	X
Vegetables					
asparagus	XX	XX	XXX	—	—
beans, lima, fresh	—	XXX	X	—	XX
beans, string	XX	X	X	—	X
broccoli	XXX	X	XX	—	XX
cabbage	X	XX	XXX	—	XX
carrots	XXX	XX	—	—	XX
cauliflower	—	—	XXX	—	XX
corn, canned	X	X	—	—	X
corn, fresh	X	X	X	—	X
dandelion greens	XXX	XX	X	—	XX
lettuce	XXX	X	—	—	XX
onions	—	X	X	—	X
peas, canned	XX	X	X	—	X
peas, fresh	XX	XXX	XXX	—	XX
peppers, green	XXX	X	XXX	—	X
potato, sweet	XXX	XX	X	—	X
potato, white	—	X	X	—	X
spinach	XXX	XX	XX	—	XXX
tomatoes, canned	XXX	X	XX	—	X
tomatoes, fresh	XXX	X	XX	—	X
Vitamin Concentrate					
cod liver oil	XXX	—	—	XXX	—
halibut liver oil	XXX	—	—	XXX	—
brewer's yeast	—	XXX	—	—	XXX

III. THE SELECTION OF FOODS

The energy value of foods. It will assist in obtaining a better understanding of the fuel value of foods, if we compare the amount of energy that may be obtained from each of the nutrients that are used for fuel. One pound of sugar or one pound of pure protein, when oxidized, will yield about 1,800 calories, whereas



One hundred calorie portions.

one pound of butter furnishes a little more than twice that amount of energy. One pound of lard, which is practically pure fat, yields a little over 4,000 calories when burned. In estimating the amount of energy contained in servings of food it should be remembered that most foods are compounds of the nutrients, a fact which complicates any computation of calorific values. Most foods contain water and minerals which cannot be oxidized. Foods of plant origin also contain cellulose which is not digested and absorbed by the tissues. It is possible to become so familiar

with servings of food that the approximate number of calories contained in them may easily be estimated with a considerable degree of accuracy

Food requirements of different rates of activity Food yielding about 1,800 calories per day is needed for the basal metabolism of a man of average weight—150 pounds In other words, his body oxidizes about half a calorie an hour per pound of body weight, or twelve calories per pound in twenty-four hours in a resting condition Of course, if he is well, he is not in bed during the whole twenty-four-hour period Consequently, he needs more than the 1,800 calories mentioned as a minimum

When a person becomes more active his fuel needs are increased Even a slight extra exertion of changing his position from lying down to sitting up will result in his using about 20 more calories an hour, and if he takes an hour's walk, he would have to add about one calorie per pound of his weight to his food consumption or 150 calories, if he weighs 150 pounds

It has been estimated that the man of average weight and sedentary habits needs 2,400 calories a day The average young person in college, who engages only in moderate exercise, needs from 2,000 to 3 000 calories a day An athlete during the football season, however, may daily expend energy equivalent to 4 000 or more calories Lumberjacks and others engaged in hard labor may need food yielding from 5 000 to 6,000 calories daily

Factors determining food needs Different factors which determine the number of calories of foods needed by different groups of people are the following age, sex, weight, basal metabolism rate, occupation climate, and general condition of health

During the rapidly growing and active periods of childhood and adolescence, the body needs a larger amount of food in proportion to size than at other times Men need somewhat more food than women since as a group they are more active, their lung capacities are somewhat greater, and their musculature better developed There are, of course, exceptions to this generalization A large individual usually needs more food than a small

NUMBER OF CALORIES IN AVERAGE SERVINGS OF COMMON FOODS[4]

KEY

c —cup
ck —cooked
hp —heaping
tsp —teaspoon
tbsp —tablespoon
E P —edible portion
diam —diameter
r —raw
med —medium

	Number
Cereals	
bread, white, 1 sl av	78
bread, whole wheat, 1 sl av	74
corn flakes, 1 c	115
oatmeal ⅔ c ck	119
rice, white, ¾ c ck	105
cracker, graham	42
saltine, 2" sq	17
Dairy Products	
butter, 1 sq, 1"	77
cheese, Amer 1¼" cube	132
cream, thin, 1 tbsp	30
cream, heavy, 1½ tbsp whipped	57
milk, whole, 1 8 oz glass	166
egg, 1 med	75
Fish and Meats	
oysters, raw, 4-6	50
salmon red, canned, ½ c	75
beef, round, lean, 3 oz	133
beef, sirloin 1 small steak	242
chicken ½ breast or 1 thigh	198
lamb chop, broiled	179
liver, beef, 2 oz.	73
pork chop, lean, 1 med	252
Fats	
olive oil 1 tbsp	126
oleomargarine, 1 tbsp	105
lard 1 tbsp	126
mayonnaise, 1 tbsp	101
Vegetables	
asparagus, 4 to 5 pcs ck	10
beans lima fresh, ½ c ck	124
beans lima, dried, ½ c ck	99

	Number
Vegetables *Continued*	
beans, string, ½ c ck	42
beet greens, ½ c ck	33
broccoli ½ c ck	37
cabbage, ½ c ck	32
cabbage, ¾ c r	16
carrots ½ c ck	45
corn fresh, 1 ear, 5"	101
onions 3 med	49
peas fresh ½ c	100
peas, ½ c canned drained	47
pepper, 1 med r	29
potato white, 1 med boiled or baked	83
potato, sweet, ½ large	123
spinach ½ c ck	24
tomato, fresh 1 med	21
tomatoes canned, ½ c	21
Fruits	
apple, 1 small	63
apple sauce ½ c scant	127
banana 1 small	99
cantaloupe, E. P., ½, 4½" diam	27
cherries, fresh 20 25 small	78
dates 3 4 stoned	98
figs, dried, 2 3 med	90
grapefruit, ½ med E P	47
orange, 1 med	49
peaches, canned, 2 halves	47
peach, fresh, 1 med	51
pears, canned, 2 halves	76
pear, fresh, 1 med	63
pineapple, canned, 1 sl ¾" thick	96

[4] Adapted from *Food Values of Portions Commonly Served*, compiled by Anna D Bowes and Charles F Church, copyrighted 1937 by the authors.

	Number
Fruits *Continued*	
prunes, dried unsweetened 5 ck., 1 tbsp juice	151
strawberries 10 large	39
watermelon E P 2" x 2½" x 1½"	30
Nuts	
almonds chocolate 4 to 8	100
almonds salted 10 to 12	100
almonds, shelled 12 to 15	97
peanut butter 1 tbsp scant	91
peanuts roasted 16 to 17 nuts	83
pecans 12 halves	110
walnuts English 8 to 10 halves	107
Sugars	
corn syrup 2 tbsp scant	102
honey 2 tbsp scant	98
molasses 1 tbsp hp	86
sugar brown 1 tbsp rounded	57
sugar white 1 tsp	20
Sweets	
chocolate milk bar 6½" x 3" x 5/16"	331
Sweets *Continued*	
chocolate fudge 1" cube	93
chocolate sauce 1½ tbsp	100
chocolate mint 1 1¾ diam	40
gum drops 3 large ⅞" diam	100
jelly fruit 1 tbsp hp	94
marmalade 1 tbsp hp	102
Desserts	
cake angel 1 med piece	133
cake chocolate layer 1 med piece iced	359
cake cup iced 1 med	275
cake sponge 1 med piece	153
doughnut 1 med	184
griddle cake 1 small 3½" diam	65
cookie oatmeal 1 3" diam	124
gelatine lemon ½ c	78
ice cream chocolate ½ qt	250
pie apple ⅙ med piece	394
pie lemon meringue ⅙ med piece	346

one The metabolic rate is also a factor in determining the amount of food needed, for the amount of energy expended increases with the rate of oxidation

People engaged in occupations that demand large amounts of energy in muscular activity also need more food than those living sedentary lives Climate influences diet For example, people living in cold regions consume more fat than those living in milder zones Finally, the physical condition needs to be considered in the selection of foods The man in good health has very different requirements from one who is sick or convalescent.

General criteria for selecting foods The intelligent selection of foods is one of the fundamentally important factors in attaining and maintaining good health It is based upon an understanding of the caloric values of different foods and an approximate knowledge of the amount of energy one uses in his everyday living

Certain standards have been set up by nutritionists by means of which one may judge if he is getting a diet adequate to meet

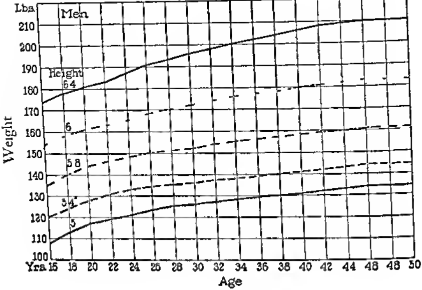
his needs These are based upon a normal rate of growth for children, and upon certain approximate weights for adults The norms have been determined by observations of many thousands of individuals An adequate diet for children consists of foods that will make possible a rate of growth which compares favorably with the norm for others of the same age, sex, and physical build Adults in good health who keep approximately the average weight for their build and type over a period of years are considered to be meeting desirable food standards

Many data have been collected bearing upon what may be considered normal weight in relation to sex, age, and height Such findings should be regarded as flexible, and not as rigid standards to be reached at any cost, as they were a decade or so ago The weight which is "normal" for one person of a given age, sex, and height is not the optimum weight for all others in the same group A 10 per cent variation from the average in either direction does not indicate, as a matter of course, real overweight or underweight and is, therefore, not necessarily a cause for worry Some persons have much heavier bones than others and there is a wide variation in what is natural for different people in the way of physique, some being of stocky build, others of medium, and still others of slender build Heredity, undoubtedly, has much to do with determining physical type

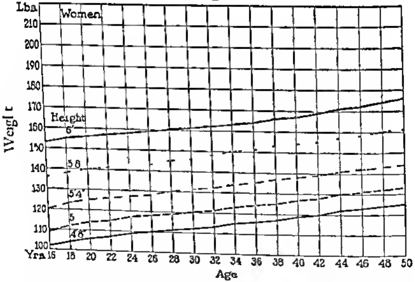
Since supplying the body with the different nutrients in proper amounts and proportions must be accomplished by the foods which are available and which we can afford, the problem of a satisfactory diet may be somewhat complicated In order that you mav be able to transpose the figures of calories needed per pound of body weight, and the proportion of the different food nutrients needed into a practical everyday diet for yourself, some suggestions may be given

A balanced diet A diet which contains the necessary nutrients in relatively the proper proportions is called a "balanced diet" It would be theoretically possible to furnish the desirable number of calories with proportionately a small amount of concen-

A

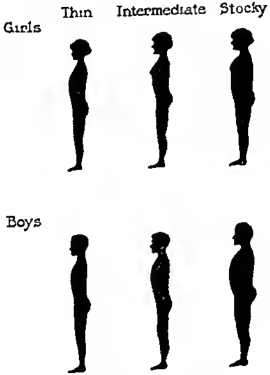


B



A. Average we ghts of men B average we ghts of women Based upon the data of the Association of Life Insurance Med cal Directors and of tl e Actuar al Soc ety of America New York 1912

trated foods Of course nobody would be so foolish as to attempt to secure the proper amount of energy-giving food merely by measuring out a certain quantity of one particular food and then eating that for a day's rations If he did, he would quickly find



Types of body builds

that he would be unable to utilize the food eaten There is need of balance and proportion in the diet.

The balanced diet contains a large amount of "protective foods," most of which do not have high caloric value and hence are not the principal sources of energy The protective foods are so named because the vitamins and minerals which are absolutely essential for health are found in them in larger concentrations than in other foods Some of them, the leafy vegetables, also contain cellulose which furnishes the bulk or roughage nec-

essary for the proper functioning of the digestive organs and to prevent constipation They promote *peristalsis*, muscular wave-like movements of the walls of the digestive tract which propel the food through it The protective foods are milk and its products, eggs, fruits, and vegetables Therefore, every day one should eat at least one green leafy vegetable, such as beet greens, spinach or cabbage, and some uncooked fruits and vegetables Lettuce is very valuable for its high mineral content as well as its vitamins Oranges and grapefruit are storehouses of vitamins and minerals, and milk should be used freely in some form every day, at least a pint for adults and a quart for children

Since most of our energy is derived from carbohydrates, they should make up the greater part of the diet There is some danger, however, of eating too much carbohydrate food Wholesome as bread and jam may be in themselves, it is possible for a child to get too much of them If too many sweets are used, the taste for the desirable fruits is frequently lost This is particularly apt to happen with children Furthermore, when the body receives more sugar and starch than it can oxidize, these substances may be transformed into fat People who have a tendency to overweight should avoid concentrated sweets and get most of the carbohydrates needed for energy from fruits and vegetables

In a balanced diet it is necessary to make sure we are getting complete proteins Again, milk is valuable for this purpose as are also meat and eggs The remainder of the proteins may be obtained from the vegetables, grains, and fruits which would naturally be found in a balanced diet The end products of protein metabolism are eliminated by the kidneys in the urine If the body gets more protein than it needs for tissue-building and repair, an extra burden may be put on the kidneys

The acid-base balance of the body Some confusion, owing probably in large measure to misleading advertising, exists in the minds of many people about the supposed relation existing between the "acidity" of foods and *acidosis*, a toxic condition of

the body It is true that most foods are *acid forming* or *alkali- or base forming*, that is, they yield acids or alkalis when utilized by the body They produce one or the other of these end results according to what compounds predominate in them However, most foods produce both acids and bases in the body, although in their total effect the balance swings either one way or the other Both acid forming and base-forming foods are needed. A difficulty may arise if either kind of food is eaten in too great quantities over a long period of time, but even then the body mechanisms can usually make adjustments that preserve the acid base balance This balance is maintained by neutralizing factors present in the blood and by adjustments made in the functioning of the lungs, heart, and especially the kidneys It varies during life less than 1 per cent

When we realize that all meats, bread, and sugar are acid-forming we can easily see why there is a tendency for substances having an acid forming effect to predominate The neutralization of these acid products may put somewhat of a strain upon the body but this is not nearly so great as many people believe A mixed diet containing an abundance of the protective foods is generally satisfactory in preserving the acid base balance

Allergies In the selection of foods many people should give careful attention to avoiding foods which set up allergic reactions These reactions may consist of rashes, eczema, hives, headaches, pains in joints, cramps, diarrhea, and symptoms resembling colds There is probably not an article of food which does not disagree with some people Allergic reactions differ widely in their severity from mild discomfort to extreme pain and sickness

Allergies should not be confused with mere idiosyncrasies in eating which ought to be overcome However, sometimes what seem to be idiosyncrasies have a physiological basis and are true allergies This subject has already been discussed in relation to asthma and hay fever (See page 157) Allergic reactions to food are probably more common than is generally recognized, and

just as skin tests and inoculations to produce immunity are being used in the case of hay fever, a corresponding technique is being employed in efforts to combat allergies to foods It has been estimated that 10 per cent of the population are more or less allergic to different kinds of proteins

The diet in relation to weight Falling below the average in weight carries with it certain physical hazards which should not be overlooked A person who is much underweight should consult a physician Young women are especially subject to tuberculosis Whether there is any connection between the amount of tuberculosis among them and their tendency to reduce is not definitely known It is, however, a conservative statement to make that many women lower their vitality through unwise dieting Health authorities agree that, at least for the majority of people, it is undesirable to omit breakfast Energy is needed in the morning to meet duties and responsibilities, and to go without breakfast is to fail to furnish the readily available fuel that is needed to create it To gain in weight one must eat an amount of food which yields more calories than are actually used

If one is overweight and dieting seems desirable, it is a much safer procedure to consult a physician than to prescribe for oneself The way to reduce, of course, is to cut down on the number of calories, while at the same time maintaining or increasing the amount of exercise A difficulty is that the additional exercise is apt to stimulate the appetite with the result that one tends to eat more than formerly The general principle to follow in reducing is to be sure that the diet contains sufficient proteins, minerals, and vitamins, while at the same time decreasing the amount of carbohydrates and fats

All kinds of claims are made regarding so called quick and safe ways of reducing Most of these methods either are of no use or they are actually harmful For example, certain patent concoctions for reducing contain thyroid extract, which has a

marked effect upon the heart and which should be taken only under a doctor's supervision (See page 125)

Another easy method of reducing, so it is claimed, is by using "fat absorbing" creams and lotions There is no evidence to indicate that these accomplish the desired results Still another method is the use of salts in hot baths However, the heat of the water is more efficacious than its brininess Usually the amount of weight lost as a result of a hot bath is quickly restored by drinking water

There are two other rather commonly used methods of reducing, neither of which is efficacious nor safe One method is to take laxatives and the other certain food preparations The habit of taking laxatives is definitely injurious They are apt to irritate the lining of the digestive tract and often result in producing chronic constipation The food preparations contain very little nourishment and usually sell at an exorbitant price A can of one of the better known varieties sells at one dollar, but contains something like five cents' worth of food A person making a meal of a spoonful of this sort of food usually makes up for it later by either eating between meals or eating heartily at the next meal

Data from life insurance companies indicate that it is desirable for most young people in the late teens or early twenties to secure plenty of nourishing food even to the extent of being somewhat overweight. On the other hand, statistics show that after middle life a person who is somewhat underweight is apt to live longer than one who is overweight and also, to a somewhat lesser degree, than the person of average weight. This does not hold true for one who is very much underweight. The overweight person is running a considerably greater risk of diseases of the heart, blood vessels, and kidneys, whereas one who is markedly underweight is more apt to be a victim of tuberculosis.

The care of foods Many foods which may arrive in the home in wholesome condition will spoil very quickly if they are not cared for properly The care of foods in the home is the par-

ticular responsibility of the housekeeper, but at times it may be the concern of every other member of the family as well All foods are perishable, but some are much more so than others and are classified under that name Their palatability and health-giving qualities depend in large measure on the care they receive

Foods are of four types perishable, dry, baked, and canned The perishable foods are milk and milk products, cooked and uncooked meats and meat products, eggs, fats, and most fresh vegetables and fruits Milk and milk products and the meats should be kept at a temperature lower than 45° F Eggs, fats, and the vegetables and fruits, with certain exceptions, should be kept at temperatures below 50° F The exceptions are apples, grapefruit, oranges, and the tuberous and root vegetables, which, however, should be stored in a cool place

Dry foods should be preserved under conditions that will keep them dry They should be placed in covered containers for protection against insects and dust Those with distinctive flavors like tea, coffee, and spices should be kept in airtight containers Baked foods should be put in covered containers which are scalded and aired once a week Moist and dry kinds should not be kept in the same box since cereal products absorb moisture very quickly Crisp crackers would not retain their crispness long, if kept in the same cotainer with a moist cake Canned foods should be stored in a cool place If they are in glass jars, they should be protected from the light

Because milk has so important a place in the diet and because it is so perishable a product some special advice about its care should be added Milk deteriorates quickly by the rapid reproduction of bacteria unless kept in a cool place, and such deterioration has been the cause of much of the sickness and many of the deaths of infants suffering from intestinal disturbances While the pasteurization of milk destroys the disease producing organisms, it does not kill all the other forms of bacteria, some of which cause it to turn sour Therefore, to keep pasteurized milk as well as raw milk pure and sweet, its temperature must be kept

down to near freezing point, since the bacteria which are still alive after pasteurization quickly reproduce if the milk is not kept cold Merely keeping milk cold does not reduce the number of bacteria already in it Milk should be kept in the refrigerator all the time it is not being used Fresh milk should never be mixed with old unless it is to be used at once Milk and cream should be kept covered in the refrigerator to keep it from absorbing odors and flavors of other foods It should be protected in every way from contamination with dirt and bacteria The safest plan is to boil milk before giving it to a baby, even if it has been pasteurized

Causative agents in food spoilage Foods may be made unfit to eat by various causative agents yeasts, molds, insects, rodents, weevils, animal parasites, and bacteria

Yeasts and molds are microscopic plants which grow very rapidly under the right conditions of temperature, moisture, and light Moist foods kept in warm dark places are favorable to their growth Both yeasts and molds serve useful purposes in the preparation of certain foods, as, for example, yeasts in breadmaking and molds in adding flavor to some cheeses They also cause the deterioration and spoilage of certain types of foods, changing their flavor and texture Yeasts may cause foods containing sugar, such as fruit juices and canned or stewed fruits, to ferment, when part or all of the sugar is changed to alcohol and carbon dioxide Molds appear on foods as powdery growths, giving them a characteristic taste and odor

Flies breed in filth and may be the carriers of the bacteria of typhoid fever, dysentery, and tuberculosis Rats and mice are destructive of millions of dollars worth of food stuffs every year Rats spread bubonic plague, a very serious disease, which appears in epidemic form and has taken millions of human lives Weevils appear in cereal products, dried fruits and vegetables, and nuts which have been kept for a long time during hot weather They are hatched from eggs laid by insects in the infested materials or in their containers

The animal parasites, trichina and tapeworms, are sometimes found in meats Rigid government inspection of meats at packing plants has made the commercial product comparatively safe There is considerable danger of infection from home dressed meats and from uncooked meat preparations, such as sausage

Harmful bacteria of various kinds may get into foods and make them unsafe for human consumption We have just spoken of the contamination of foods by carriers of the bacteria which cause typhoid fever and some of the other infectious diseases Other types of bacteria may also get into foods, multiplying in them and producing dangerous poisons, especially if they are not kept at sufficiently low temperatures to arrest their growth The eating of these foods causes serious illness and, in the case of poisons produced by one specific type of bacterium, frequently results in death

VII

THE DIGESTIVE PROCESS

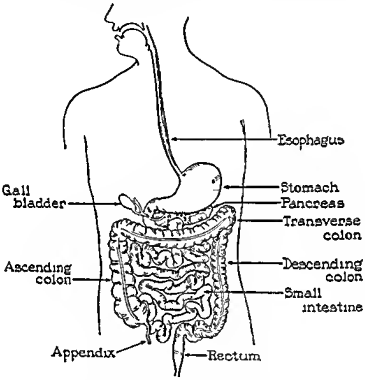
1 STRUCTURE, FUNCTION, AND CARE OF THE DIGESTIVE ORGANS

The meaning of digestion Digestion is the process of preparing food to enter the blood Water, dissolved salts, and glucose do not need to undergo any change to do this Proteins, fats, and the other carbohydrates except glucose have to be changed chemically by the digestive juices before they can be utilized by the body The molecules making up most of our foods are too large to permit them to pass through organic membranes They have to be split or broken up into smaller molecules in order that they may pass into the blood stream in the walls of the small intestine The process of breaking down food molecules into simpler ones is accomplished by *enzymes*, which are organic substances capable of bringing about chemical changes in other substances without themselves being altered in the process

The digestive system consists of the following parts (1) a continuous tube, the *alimentary canal* or *digestive tract*, twenty-five to thirty feet long in the adult, which begins with the mouth and ends with the *rectum* opening to the exterior through the *anus*, and (2) certain glands which empty their secretions through ducts or tubes into the alimentary canal These glands are the salivary glands, the liver, and the pancreas In addition there are glandular cells in the walls of the food tube itself which secrete digestive juices

The principal parts of the alimentary canal, between the mouth and the anus, are given the following names and occur in the order mentioned (1) the gullet, or esophagus, (2) the stomach, which is situated in the abdominal cavity a little below the dia-

phragm, (3) the small intestine, which is about twenty feet in length, and (4) the large intestine The large intestine begins in the lower right-hand side of the abdominal cavity and consists of the following parts the *caecum*, to which is attached the



The alimentary tract

appendix, the *ascending colon*, the *transverse colon*, the *descending colon*, the *sigmoid flexure*, the *rectum*, and the *anus*

Foods are digested in the mouth, stomach, and small intestine By the time the digested material reaches the large intestine most of the nutritive substances in it have been absorbed, although a considerable amount of water still remains, a large part of which is absorbed in this part of the alimentary canal The *feces*, which is the name given to the residue, is passed out of the body through the anus

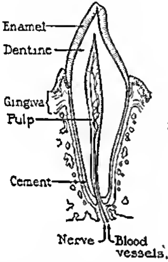
The development of the teeth The first step in the digestive process is the mechanical one of *mastication*, or chewing, which breaks the food into particles small enough for the digestive juices to work upon easily Because the teeth perform the first act in the digestive process we shall describe them before studying the other organs of digestion Since we have only two sets of teeth, the wise person gives them the best of care for faulty teeth make the proper mastication of food either difficult or impossible, and they are much more susceptible to decay and other disorders than sound teeth The condition of our teeth has an important effect upon health

The kind of teeth we have was determined in large measure before we were born and during the early years of life This is owing to the fact that the body must receive an adequate supply of the materials of which teeth are made during the period in which they are being formed Many experiments have demonstrated that the essential substances are the minerals, calcium and phosphorus, and the vitamins, A, C, and D Expectant mothers should be especially careful to eat food containing an abundance of these materials, and during the first few years of life they are needed in large amounts (See page 109) In fact, since the teeth need nourishment, as do other parts of the body, it would seem reasonable to assume that they may be weakened by nutritional deficiencies at any time in life and strengthened by a proper diet, although the critical period is that in which they are being developed

The structure of the teeth The teeth are set in sockets in the bones which form the jaw They are not a part of these bones, but are held in place by *cementum*, a substance resembling bone. The *crown* of the tooth consists of the part that can be seen plus a small portion extending below the gum Covering it is a layer of *enamel*, the hardest substance in the body, composed almost entirely of calcium phosphate and calcium carbonate. If because of some disorder, the gum recedes, a part of the tooth which cannot normally be seen comes into view, exposing all

of the enamel and frequently some of the cementum as well. The *root* is the part of the tooth below the crown.

Most of the interior of a tooth consists of a substance called *dentine*, which also resembles bone, but is harder. The dentine surrounds the *pulp cavity* which contains blood vessels and nerves, and also the *root canal*, a continuation of the pulp cavity



Section of a tooth.

through which the blood vessels and nerves pass. Thus the lining cells which help to compose the tooth are brought into relationship with other parts of the body and receive nourishment and oxygen and are able to get rid of the products of their metabolism.

The permanent or second set of teeth numbers thirty-two. Starting from the middle line of the front of each jaw and proceeding toward the back of the mouth, there are two incisors, one cuspid, two bicuspids, and three molars. There are twenty teeth in the first or temporary set. Babies usually "cut" or erupt their first teeth, the two middle lower incisors, at about the age of six or eight months. These are followed in the next few months by the four upper incisors. Dentition of the "milk"

teeth continues until about the age of two and a half years These teeth are in the gums and fairly well formed when the baby is born After they are erupted the permanent teeth begin to develop below them The first teeth are shed as the second teeth are ready to erupt If dentition is normal, this period of eruption continues from about the age of six to twelve years, with twenty-eight teeth in all being cut The four third molars, or "wisdom" teeth, usually are erupted between the ages of seventeen and twenty-five years

It is a mistake to think that the first teeth do not require any special care because they are temporary It is very important for the health of the permanent teeth that the temporary set should be sound and not lost prematurely They help to regulate the eruption of the second set, assisting them to come in straight and in correct alignment The latter are apt to come in irregularly if many of the first teeth are lost before the second teeth are ready to erupt A child should be taken to a dentist twice a year to have his teeth inspected and cleaned from the time he has his complete set of first teeth

Dental caries Dental caries is the name given to ordinary tooth decay It is the most common type of trouble with teeth Although the causes which predispose an individual to this disorder are not all thoroughly understood, observations tend to show that caries is less likely to appear in the teeth of people who have a satisfactory diet, that is, one which contains the essential minerals and vitamins In fact, there is evidence to indicate that a diet adequate in these respects may establish a resistance to decay in teeth that were originally defective.

A deficiency of teeth building materials in the diet will cause the teeth to be soft and irregularly formed They are in a condition more susceptible to attack by bacteria present in the mouth If food materials are allowed to remain in the little crevices in teeth or between them, bacteria grow in them and produce a weak acid, lactic acid, which may gradually bring about the decay of the enamel, exposing the dentine. Once this

happens the bacteria can make more rapid progress since dentine decays much faster than enamel and since the bacteria cannot be dislodged

Care of the teeth Although correct diet is believed to be the prime essential in the formation of teeth and in the maintenance of their health, there are certain other measures that should be taken to safeguard them The teeth should be brushed at least at night before retiring and upon rising in the morning Dental floss should be used to remove particles of food which may become lodged between the teeth where the brush will not reach Since the dentist can detect the existence of cavities long before one has a toothache and before the decay has progressed very far, a good rule to follow is to go to the dentist every six months for a thorough checking for cavities, and to have the teeth cleaned It is less expensive to have small cavities taken care of than to allow them to become enlarged before attending to them If they are so neglected, it frequently happens that teeth have to be extracted and then bridgework, a denture, or a plate becomes necessary When a dentist cleans the teeth he removes the tartar which comes from saliva and collects around the region where the crown and root of the tooth meet If this is not removed regularly, it tends to accumulate and causes the gums to recede and become sensitive

The cause of abscesses at the roots of teeth is not always known Sometimes they are caused by bacteria that have been introduced into the root canal when the cavity in a dead tooth has been filled The danger of abscesses forming at their roots is one of the main reasons why many dentists always advise the removal of dead teeth It is generally agreed that if a dead tooth is allowed to remain in the jaw, it should be X rayed from time to time, perhaps once a year, to be sure that no abscess has formed at its root. The X ray photograph is frequently the only way to determine whether one is present An abscess may exist for months and even years without causing pain Sometimes these abscesses discharge through gum boils Generally speaking,

however, they do not give any definite local evidence of their presence, but drain into the blood stream spreading bacteria and perhaps producing secondary foci of infection

Extravagant claims are often made over the radio and by other methods of advertising regarding the virtues of certain tooth pastes and mouth washes Most tooth pastes and preparations of liquids that are used in brushing the teeth leave pleasing sensations in the mouth and stimulate one to clean the teeth more frequently In this respect they may serve a useful purpose However, one can obtain just as good results, if not better, merely by using bicarbonate of soda to which may be added a little salt, or by using finely precipitated chalk Some tooth pastes contain abrasives which may cut into the enamel and some liquids used as mouth washes are injurious since they irritate the mucous lining of the mouth No antiseptic liquids have been made that can prevent or cure halitosis or rid the mouth of all, or even the majority, of bacteria that are normally present in it They do not prevent or cure *pyorrhea,* which is a condition characterized by the receding of the gums In advanced cases of pyorrhea the teeth become loose and fall out Negligence in the care of the teeth is a contributing factor Its cure is dependent upon treatment by a dentist

Trench mouth, or *Vincent's disease,* is a very infectious disease of the gums, caused by a specific bacillus The gums and sometimes the tonsils and mucous membranes of the throat become ulcerated and bleed This disease may be cured in a short time by proper treatment by a capable physician

The physiology of digestion The first of the digestive juices with which the foods come in contact is the *saliva* of the mouth This juice is manufactured in three pairs of glands located near the mouth cavity and flows through ducts which empty into it It has a slightly alkaline reaction which helps to protect the teeth from the effect of harmful bacterial action It moistens the food and makes it slippery so that it more easily passes into the esophagus

The saliva, which is almost entirely water, contains an enzyme, known as *ptyalin*, which produces a chemical change in starch, turning it into dextrin Although the digestion of starch is begun in the mouth, it is not completed until after the food reaches the small intestine Food should be well masticated, not only to break it up effectively but in order to permit time for the saliva to start the digestion of starch The flow of saliva is stimulated by the presence of food and also by psychical factors, such as pleasing food odors or the sight or even the thought of food when hungry During mastication the food is gradually formed into a small mass, or *bolus*, with the aid of the tongue and swallowed

Since the trachea opens into the throat cavity immediately in front of the esophagus, one may wonder why the food does not frequently go down the wrong tube It seldom does because the opening into the trachea is automatically closed in the act of swallowing by a structure called the *epiglottis* If food does happen to enter the upper part of the trachea, it is usually expelled at once by a paroxysm of coughing or choking After the food enters the esophagus it passes down to the stomach by means of peristalsis, which we have previously referred to as wavelike contractions and relaxations of the muscles in its walls

When food enters the stomach, digestion is continued by means of the *gastric juice* which is manufactured in the walls of the stomach This juice contains the enzymes, *pepsin* and *rennin*, as well as hydrochloric acid which creates the acid medium necessary for the work of these enzymes Like the other digestive juices, it consists principally of water The pepsin acts upon proteins, bringing about the first steps in their digestion Rennin helps to digest any milk which may be present. Fats are acted upon in the small intestine The digestion of starch continues for a time, but it is usually stopped within half an hour by the effect of the acidity of the gastric juice The hydrochloric acid dissolves mineral matter and cellulose which may be present in the food It also helps to destroy any harmful microorganisms

During the time the food is in the stomach it is broken up into still smaller particles and thoroughly mixed with the gastric juice by gentle motions of its walls It is about the consistency of thick soup when it is forced into the small intestine in a series of intermittent spurts by the wavelike contractions of that part of the stomach walls which is adjacent to the intestine It passes out through an opening resulting from the relaxation of the *pyloric sphincter*, a ring of muscle situated at the junction of the stomach with the *duodenum*, the first part of the small intestine This muscle is contracted during most of the time that stomach digestion is proceeding, but it relaxes at intervals, thus permitting the food gradually to be moved into the intestine

The length of time the food remains in the stomach depends on several factors, such as the nature and size of the meal and the emotional condition of the individual It normally remains in the stomach from one half to four or five hours after eating Proteins and fats are retained longer than carbohydrates. When the food reaches the small intestine it is met by certain juices which complete the work of digestion These are the *pancreatic juice*, secreted by the pancreas, an organ which lies back of the stomach, the *intestinal juice*, secreted by certain cells in the wall of the intestine, and the *bile juice*, made by the liver Part of the bile juice is stored in the gall bladder until needed

The pancreatic juice and the bile juice are emptied into the small intestine near the stomach The pancreatic juice contains several different kinds of enzymes One of these completes the digestion of most of the proteins, reducing them to amino acids. The rest of the proteins are acted upon by an enzyme in the intestinal juice which also changes them into amino acids. Another enzyme of the pancreatic juice with the aid of the intestinal juice completes the digestion of starches and sugars, finally changing them into glucose The fats are digested by the joint action of the intestinal and pancreatic juices facilitated by the alkaline medium of the bile juice.

The large intestine The residue of the food passes from the

small intestine into the large intestine from which it is excreted Since this part of the alimentary tract serves as an excretory organ it will be treated later in the chapter which deals with excretion

The purpose of all of this activity of the digestive juices is, as we have stated, to transform the insoluble nutritive materials into substances that can enter the blood The passage of these nutritive substances into the blood or lymph through the walls of the alimentary canal is called *absorption*

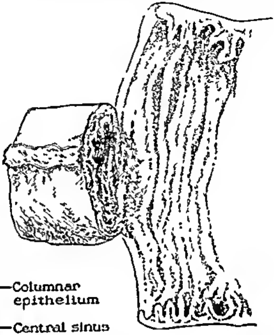
Absorption Most of the absorption of the nutrients occurs in the small intestine By the time the mass of material has reached the large intestine, practically all the digested substances have been absorbed from it There is left to pass into the large intestine the nutrients which did not happen to be digested, indigestible materials like cellulose, certain other substances such as bacteria, and excretions by the liver and large intestine

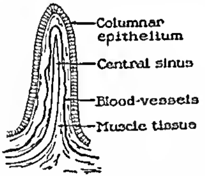
The inner walls of the small intestine are convoluted, or thrown into ridges or folds upon which there are great numbers of microscopic fingerlike projections called *villi* The villi greatly increase the area through which nourishment may pass into the blood The blood in their capillaries is separated from the food mass in the intestine by only a thin membrane through which the digested proteins and carbohydrates, along with the dissolved salts and some of the water, are absorbed The blood flowing from the intestines goes directly to the liver, where part of the glucose is stored as glycogen, to be returned to the blood later as glucose and used in the cells where needed (See page 119) The amino acids, salts, and water are carried to the tissues where they are used largely for processes of building and repair

The digested fats reach the blood by a more devious route They enter the *lacteals*, ducts in the center of the villi which connect with other larger ducts, all of which empty into the lymphatic system (See page 48) Since the contents of the lymphatic system are discharged into a vein near the heart, the

digested fats eventually enter the blood and, by this roundabout route, are also made available to tissues all over the body.

The emotions in relation to digestion. Pleasant companions at meals and attractive surroundings and service help to create a





Above, convolutions of the inner wall of the small intestine; left, a villus.

situation in which the various juices flow more freely and the gentle motions of the stomach, which help to mix the food with the gastric juice, proceed with a high degree of efficiency. The odor and appearance of attractive food not only result in making the mouth water when one is hungry, but the stomach also begins to secrete the gastric juice. *Therefore*, when food is swallowed stomach digestion can begin immediately.

The reverse of these statements is also true. Any unpleasant

happening while eating, or badly prepared unattractive food, may take away one's appetite and interfere with digestion. Intense arguments at meals frequently result in attacks of indigestion. It is sensible to give a little forethought to making eating pleasant and attractive. One cannot always avoid unpleasantness, but generally speaking this is possible. Tension, worry, and fatigue interfere with digestion. They create an emotional disturbance which prevents the proper manufacture of digestive juices and tends to stop the muscular activities of the digestive tract. It is foolish, therefore, to eat heartily when one is overtired. In fact, the sensible thing to do is to rest for a short time before eating. Many cases of indigestion are owing to nervousness and worry. Here again we have an example of the importance of being able to relax. It has been found that loud noises interfere with digestion. Recently many restaurants have been made much more attractive and hygienic by installing sound-absorbing surfaces on the floors, walls, and ceilings.

Experiments have been performed on dogs and cats to observe the effects of different kinds of emotions upon their digestive processes. The motions of the walls of the alimentary canal can be seen by means of the *fluoroscope*, which is a device for observing shadows cast by objects in the path of X-rays upon a specially prepared screen. It has been observed that when a strange dog is brought near a cat which is enjoying a meal, the cat stops eating and the gentle churning movements of its stomach cease. When the dog is taken away the cat regains its composure and digestion proceeds normally. An investigation of a similar type was carried on among some students. Its purpose was to determine how long an interval of time elapsed before the meal began to leave the stomach and enter the small intestine. At first the students were made nervous by the technique employed in the observations, and digestion was retarded. As they became accustomed to the experiments it was found that the food left their stomachs at shorter intervals, which indicated that digestion was proceeding normally.

II DISORDERS OF THE DIGESTIVE SYSTEM

Indigestion is a general term frequently applied to conditions in which there are symptoms of discomfort, flatulency and pain in the abdominal region For some reason one or more of the intricate processes occurring in the digestive tract fails to function normally Indigestion frequently is not associated with any particular disease but may be caused by indiscretions in choice of foods, overeating, eating hurriedly, eating when overtired or nervous, and by allergies and infected foods Chronic indigestion should not be neglected because it may be a symptom of a serious disease like appendicitis, stomach ulcer, or cancer It is always a cause for consulting a physician

Food poisoning Cases of food poisoning are constantly occurring, especially in hot weather They are caused by bacterial infection of special types of foods and are of two kinds, depending upon the nature of the causative organisms general food poisoning and botulism Bacteria of the enteritidis group are the most common causative organisms of general food poisoning Staphylococci that produce a soluble toxin have also been found in foods which have caused acute illness a few hours after eating Symptoms of this general type of food poisoning are vomiting, diarrhea, and abdominal pains They are usually followed by complete recovery

Many cases of this poisoning occur from the eating of whipped cream and custard products which have been contaminated by bacteria when they were being made or distributed and which are not kept properly refrigerated Cold meats and fish, sandwiches made with meat or fish fillings, and salads also require proper refrigeration and protection from contamination Picnics and all day automobile trips with basket lunches are occasions sometimes followed by food poisoning from these sources

People should refuse to buy prepared foods of this kind unless they are under proper refrigeration at the time of purchase If

possible, they should have some guarantee that they are produced under sanitary conditions which would include cleanliness of the premises, physical examination of the food handlers, sterilization of equipment and correct refrigeration When foods of this kind arrive in the home, they should be put in the refrigerator at once

Botulism Botulism is the name of a serious type of food poisoning caused by the bacillus botulinus It is found in soil practically all over the world The bacteria produce a poison which is very dangerous They grow in the absence of air and light. The disease results from eating improperly canned vegetables, meats, and fish Its symptoms are loss of ability to swallow and talk, rapid pulse and subnormal temperature, constipation, weakness, and difficulty with vision There is rarely any pain The symptoms develop within forty eight hours after eating the poisonous food Botulism is fatal in over 60 per cent of the cases Fortunately it is rather rare, such cases as do occur are mostly because of improper home canning There has been no case of botulism from American commercially canned food in several years The bacteria are destroyed by thorough sterilization The poison itself is destroyed by boiling Home canned foods are reasonably safe after they have been boiled for 30 to 45 minutes after their removal from jars or cans Usually the infected food shows signs of spoilage, but not always If suspected, food should not be even tasted until it has been boiled Adequate education of housewives in newer methods of home canning is necessary to prevent this disease

Cancer Cancer may attack any part of the body, but in approximately one third of all the deaths from this disease the stomach is the organ affected It is more apt to prove fatal when it attacks an internal organ such as the stomach or lungs than when it appears upon the skin or some tissue near one of the body openings This is partly because it is frequently not discovered in the early stages and partly because it is not so easily treated

Cancers are most likely to occur in the stomach, the breasts, the uterus, the skin, or the lips More women are attacked by this disease than men At present in the United States about 80,000 women and 60 000 men die of cancer every year A complicating factor in diagnosing a cancer of the stomach is that ulcers may give rise to the same sort of symptoms as those produced by a cancer, thus delaying its correct treatment

The methods employed in the treatment of cancer depend upon its location If it is a surface growth or near the surface, surgical removal or radium may be used If it is deep seated, X rays or surgery are the most effective methods of treatment. No kind of drug is known that will cure cancer Massage is not only of no use, but actually dangerous since it may result in further irritation and cause the disease to spread to other parts of the body It cannot be repeated too often that the only known methods of control of cancer are early discovery and complete eradication

Stomach ulcers An ulcer in the stomach is an inflamed area which is irritated by the hydrochloric acid The tissue, which is killed by the process of inflammation, is digested by the pepsin of the gastric juice just as a piece of meat would be. This action of the gastric juice makes it difficult for the ulcer to heal It is also difficult to treat because the affected part cannot easily be rested and it is constantly being irritated by the presence of the gastric juice Sometimes the ulcer actually forms a hole through the wall of the stomach, when an immediate operation is necessary More commonly scar tissue is formed at the base of the ulcer which prevents a perforation of the wall of the stomach Ulcers may also form in the wall of the duodenum close to its junction with the stomach For the treatment of these gastric ulcers the physician usually recommends a diet consisting largely of milk and cream

Appendicitis The appendix is located in the lower right hand side of the abdominal cavity It is attached to the caecum, the name given to the pouch that forms the beginning of the large

intestine It is at present of no known use, although it is believed to have served some useful purpose to the ancestors of man sometime in the remote past It is an illustration of the so called vestigial organs of the body (See page 59)

Today the appendix is not only useless but a potential source of great harm in the body Appendicitis is the name given to the disease resulting from its inflammation The symptoms of appendicitis are usually severe pains in the abdomen, which are generally but not always accompanied with nausea and vomiting and with a slight rise in temperature The pains are not always in the region of the appendix Anyone suffering from severe abdominal pains should call a doctor and go to bed Under no circumstances should he take a cathartic because it irritates the intestinal tract and makes it more likely that the appendix will rupture

The doctor usually has a blood count made immediately by means of which he can obtain additional information as to the probability of appendicitis (See page 81) When all the symptoms of the patient and the findings of the blood count point to the probability of an infected appendix, it is the part of wisdom to have the operation performed as quickly as possible Less than 1 per cent of those operated upon in the first day of an attack of appendicitis die of the disease, whereas if there is a delay of four or five days the chance of a fatal result is increased more than ten fold The danger is that the appendix may rupture and liberate bacteria and their poisons into the abdominal cavity In this event the condition of the sufferer becomes much more serious because the membranes of the abdominal cavity *become inflamed and the infection is spread Peritonitis, as this* condition is called, has a much higher mortality rate than appendicitis

Typhoid fever Among the more serious disorders which attack the body by way of the alimentary canal, typhoid fever is outstanding This disease is caused by a specific organism, the typhoid bacillus It is spread in only one way—improper disposal

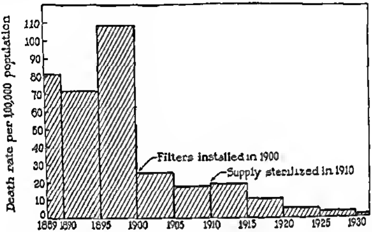
of human excreta Typhoid bacilli first live in the digestive system and then in the blood of sufferers from the disease They may be found in the feces and urine of typhoid fever patients If human excreta are not properly disposed of, the bacteria may find their way into the bodies of other human beings The most common manner in which this occurs is through contamination of water and milk supplies It has also been demonstrated that flies may carry the bacteria, if they alight on the excreta of typhoid fever victims and then upon foodstuffs used by human beings Sometimes fruits and vegetables eaten raw and oysters grown in contaminated oyster beds may be sources of infection

Typhoid fever may also be spread by what are known as "carriers" (See page 78) Many persons who have had typhoid fever continue to give off bacteria in their urine for a few weeks after recovery, and some do this for a longer time, in some instances apparently for the remainder of their lives Such carriers should not be handlers of food A typhoid carrier working in a dairy, or a typhoid patient on a dairy farm where wastes are not carefully disposed of, may be the means of polluting the milk supply of large numbers of people A cook, who became famous in medical literature as "Typhoid Mary," spread this disease among the members of several families where she was employed In recent years a considerable number of typhoid carriers have been discovered and are supervised by Boards of Health to protect others from danger

Typhoid fever is especially apt to occur in epidemics Stream pollution has been the most common cause Many towns obtain their water supply from rivers, leading it off through pipes above the place where the stream flows by the city The sewage is emptied into the stream at a point somewhere farther down the river It frequently happens that a number of towns are located in a series along the banks of a river When this is the case it can readily be seen how an epidemic of typhoid fever, appearing first in the town located upstream, might later be carried to the

town downstream. Such contaminated water may, to all outward appearances, be perfectly pure.

This contamination of the water supply happened rather frequently before it was known that typhoid fever might be spread in drinking water, and means were devised for purifying it. In recent years, however, owing to the advance of sanitary science,



The effect of water purification on typhoid fever death-rates in Albany, N. Y. This is typical of similar reductions throughout the country. (*From* "Public Health in New York State," *a report of the* New York State Health Commission.)

typhoid epidemics seldom occur in highly civilized, progressive communities. Sand filters, sedimentation, and chlorination processes are used to purify water supplies. Improved sanitation, which includes the proper disposal of human wastes, the purification of water, and the inspection and pasteurization of milk, and the use of typhoid vaccine, are the main factors reducing the incidence of typhoid fever.

The efficacy of typhoid inoculation has been proven many times. In the United States Army when vaccination became compulsory typhoid fever practically disappeared. There were six times as many deaths from typhoid fever during the Spanish-American War as from the bullets of the enemy. This was

before inoculation against the disease had been discovered Vaccination is especially recommended for persons doing considerable traveling, for doctors, nurses, and internes who have to take care of patients suffering from the disease, and for people in whose families there is a case of the illness The immunity resulting from the inoculation usually lasts about two years

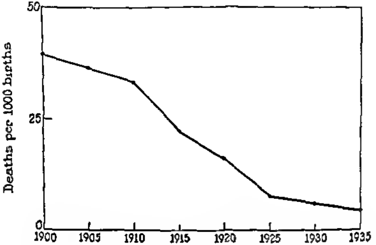
The typhoid bacillus is one of the kinds of bacteria that do not produce pure toxins, which are poisons given off during the life of the bacteria, but instead liberate poisons as a result of their disintegration Such poisons are known as *endotoxins* because they are formed after the bacteria die Typhoid bacterin with carefully measured amounts of typhoid endotoxins may safely be introduced into the body When so introduced, certain reactions occur which result in overcoming the small amount of endotoxin inoculated and at the same time set up in the body an active type of immunity (See page 94)

Dysentery of bacterial origin Dysentery is an inflammation of the large intestine with bloody and loose evacuations It may be produced by bacteria or by animal parasites We are here considering the former type which is caused by a specific organism and which in our part of the world is more common The disease is spread in much the same manner as typhoid fever—by transmission of infectious materials and by contaminated water and milk supplies It may attack anyone, although infants are most susceptible

Infant diarrhea The total number of deaths in the first year of life has been reduced in the last thirty years from approximately 170 to 67 per 100,000 births Much of this gain has been due to the control of infant diarrhea The fight against infant diarrhea has centered for the most part in efforts to furnish to babies a supply of pure, uncontaminated milk In the early part of the present century a public spirited man, Nathan Straus, recognized the need of providing pure milk during the hot summer months to the babies of poor parents He started the movement to establish milk stations in the slums of New York

City where the poor could obtain the proper kind of milk for their children This movement spread throughout the country and brought forcefully to the attention of parents and health officials the need for greater care in infant feeding, especially during the summer

The widespread pasteurization of milk has also been helpful,



Gastro intestinal conditions in infants showing the consequent infant mortality in New York City since 1900

not only in reducing the incidence of infant diarrhea, but also in preventing the spread of tuberculosis, typhoid fever, diphtheria, septic sore throat, and scarlet fever

Amebic dysentery Amebic dysentery is caused by a one celled animal called *amoeba histolytica* Until recently it was uncommon except in the tropics, but in the last few years it has been widely encountered in our own country An epidemic of this disease occurred in Chicago during the exposition in 1935 Through faulty plumbing in one of the Chicago hotels, sewage seeped from a leak in the drain pipe into the water that was used for drinking

Trichinosis Trichinosis is caused by trichina or, to speak more scientifically, *trichinella spiralis*, a worm about one sixth of an

inch in length (See page 198) The disease is spread only by eating undercooked infected pork Thorough cooking of pork results in killing these worms If they gain access to the intestines, they quickly reproduce there and bore their way into the blood stream through the blood vessels in the intestinal walls As the blood circulates through muscular tissues, they leave it and enter the muscle cells where they finally go into a quiescent stage The disease is apt to result fatally

Disease caused by tapeworms Among the most common varieties of tapeworms found in man are those known as *taenia saginata* and *taenia solium* The former lives part of its life in a cow and the latter in a hog The hog variety, although smaller—a fully developed worm is about nine feet long—sets up a much more serious disease than the cow variety which may grow to be five or six times the length of the other Another kind, that infests fish, is also capable of growing in the human body and is quite common in some parts of the country These worms have little hooks or suckers on their anterior ends by means of which they fasten themselves to the inner walls of the intestines When either kind enters the body it is very tiny, consisting of what will later become the head and neck of the worm Segments are developed from this which become flattened out, hence the name tapeworm A fully developed worm consists of hundreds of these segments As the segments mature, eggs are developed in them These are later given off and excreted from the body in the feces.

If the eggs of these worms happen to get on food eaten by either a cow or a hog depending upon its species, they are hatched in the body of the animal and development proceeds up to the point of producing a head and neck This structure, known as a *prescolex*, becomes embedded in muscular tissue If the animal which is its host happens to be used for human food and the meat is eaten raw or in a partially cooked condition so that the prescolex is not destroyed, the worms begin to develop in the food tube of their new host Such parasites need no digestive

systems of their own since they grow by absorbing the digested food of their hosts Thorough cooking of meat will always kill them It is most common where unsanitary outdoor toilets are used

Hookworm disease The hookworm is also a dangerous enemy of mankind It is confined to the tropics or to subtropical regions and is very prevalent among the poorer classes of some of the southern sections of the United States Hookworm disease is caused by small worms which fasten themselves by means of hooks to the inner walls of the intestines where they suck the blood of their victims The wounds, thus made, do not heal readily and the result is a decided weakening of the body, if any considerable number of worms is present

The young worms enter into the body through the skin, usually of the hands or soles of the feet, and get into the blood After entering the blood, they are carried to the lungs and bore their way through the thin walls of the membranes of the alveoli From there they make their way through the air passages to the throat and are then swallowed They pass through the stomach and finally reach the intestines where they grow to maturity and carry on their work of draining the blood of their victims

The disease is spread by pollution of the soil with the excreta of its victims, since the eggs of the worm are passed in the feces and hatch in the soil The worms live for a period of about five years in the body unless measures are taken to get rid of them The amount of harm resulting from this disease depends in large measure upon the number of worms in the body It is possible from a microscopic examination of the fecal matter to determine in any individual case the approximate number of worms present in the intestines The wearing of shoes and the use of sanitary privies as well as the education of the people as to the nature of the disease and how it is spread are all necessary methods of combating it in localities where it is endemic

»» VIII ««

DISTRIBUTING SYSTEM OF OUR BODIES

1. THE ROLE OF THE CIRCULATORY SYSTEM

Some interrelationships of the circulatory with other systems of the body The study of the human body is something like the putting together of the different parts of a picture puzzle. For example, we might start with a puzzle at any place—top, bottom, sides or middle Regardless of where we begin, the picture does not become clear until we have proceeded some distance with it. Likewise in our study of the human body it is possible to begin with a consideration of any one of the organs or systems, but it is not until we have progressed quite a way with our project that their interrelationships and the true meaning of harmonious bodily functioning begin to stand out clearly.

We have purposely postponed the consideration of the circulatory system until after our study of certain other bodily mechanisms, because knowledge of these mechanisms furnishes a ready means of integrating many different aspects of our study of the principles of healthful living In studying these other mechanisms we have found ourselves compelled, many times, to describe some way in which the blood assists in their functioning You may have noticed that it has always done this by carrying materials to and from the various parts of the body In other words, it has acted as a distributing agent.

In the chapter on exercise, posture, and relaxation we found that the blood must supply the bone-forming cells with certain minerals, especially calcium carbonate and calcium phosphate, if the skeleton is to develop normally We learned that muscle cells

must have oxygen and glucose if they are to function, and that both of these materials are brought to the muscles in the blood and lymph Furthermore, the role of the blood in carrying internal secretions, such as thyroxin and insulin, was mentioned Also in our study of the nature of fatigue it was found that activity involves the accumulation of waste products in the blood stream from which they must be eliminated if the organism is to recover from the effects of its activity

The remarkable recuperative power of the body is due in large

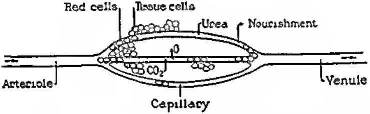


Diagram showing some of the exchanges occurring between the blood in the capillaries and the surrounding tissues

measure to the very effective machinery it possesses for ridding itself of the wastes that are constantly being produced by its multitude of cells and given off into the lymph and blood In the chapter on air and breathing attention was called to the mechanisms by means of which the blood is enabled constantly to get rid of carbon dioxide and acquire fresh supplies of oxygen

In the chapters dealing with foods and digestion we learned that the nutritive materials in foods are made soluble and in other ways prepared to enter the blood and lymph, which distribute them to all parts of the body We have also learned that there are present in the blood certain mechanisms for fighting disease the white cells which possess the power of destroying certain pathogenic bacteria, and the antibodies that are essential in establishing immunity Finally, we know that the blood may be, and frequently is, the means of disseminating throughout the body, not only pathogenic organisms and their poisonous prod-

ucts, but also various remedies to combat disease, such as those used in inoculations

From the foregoing statements it is evident that the blood as a distributing agent, plays an essential part in body activity It carries on its work because it circulates through every part of the body Questions which naturally arise are How is the blood made to circulate? What are the basic facts about the physiology and hygiene of the circulatory system with which the average intelligent person should have an acquaintance in order to protect his own health and that of others? The diseases of the circulatory system are among the most common causes of death It is the part of wisdom to learn something about their symptoms and possible prevention

II THE BLOOD AND LYMPH

Parts of the circulatory system The circulatory system consists of first, the blood, second, the heart, third, the blood vessels of which there are three kinds—arteries, capillaries, and veins, and fourth, the lymphatic system Through the arteries blood moves away from the heart through veins it flows toward the heart The network of capillaries, found in great numbers throughout the body, forms the connecting links between the small arteries and the small veins With the exception of the blood vessels connected with the lungs, the arteries contain blood that is rich in oxygen and poor in carbon dioxide whereas in the veins the blood is poor in oxygen and rich in carbon dioxide

The discovery of the circulation of the blood Before the seventeenth century it was not known that the blood circulated in the body It was thought that the arteries contained air—hence the name artery, which means air tube The arteries were thought to contain the vital spirit or breath of life One of the reasons for this idea was that the large arteries were found to be empty after death

In 1628 an English physician, William Harvey, first described

the movement of blood as a true circulation There were no microscopes at the time, so it was not possible actually to see the blood flowing through the capillaries, in fact, it was impossible to see the capillaries Harvey's hypothesis was, however, based upon a number of careful observations He postulated that there must be very fine tubes connecting the arteries with the veins, and before the end of the century the blood flowing through capillaries was actually seen by means of a crude microscope. Today it is a simple laboratory exercise to demonstrate the flow of blood through capillaries in the web of a frog's foot or in the tail of a small fish Harvey's work was ridiculed at first, but later it came to be accepted as one of the great scientific discoveries, constituting a beautiful example of logical reasoning

Any particular portion of blood, whether a part of the liquid or one of the corpuscles, travels from the heart and back to it, time and time again, as long as it remains in the blood stream It takes less than a minute to make a complete circuit The blood is pumped from the right side of the heart to the lungs, from the lungs it goes to the left side of the heart, whence it is pumped to all parts of the body except the lungs, finally returning again to the right side of the heart

The lymphatic system It is sometimes said that the blood circulates through the body in a closed system of tubes but this is not quite true, since a part of the blood is constantly escaping through the walls of the capillaries This fluid is called lymph (See page 48) It differs from the blood principally in that it contains no red cells or other cellular constituents, such as white cells and the very fragile cells, called *platelets*, which assist the blood to clot

The lymph does not remain stagnant but bathes all the living cells as it flows slowly past them In its course it gives up oxygen which it receives from the red cells, and nutritive materials, while at the same time there pass into it the products of protoplasmic activity, such as carbon dioxide, water, lactic acid, and the end products of protein metabolism It flows into microscopic vessels

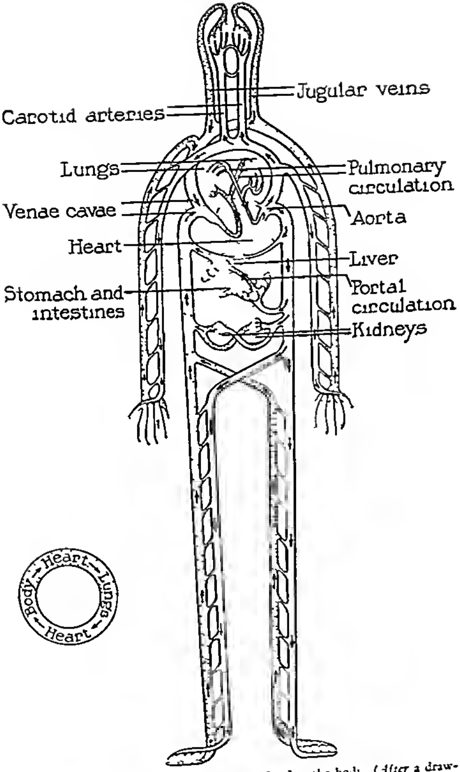


Diagram showing the circulation of the blood in the body (*After* a drawing in *Fortune*, November, 1937)

which upon uniting with each other form larger vessels, and is finally returned to the blood stream, entering it in a large vein near the heart The vessels through which the lymph flows constitute the *lymphatic system*

Perhaps a figure of speech may be helpful in understanding the general nature of the flow of the lymph Its flow may be likened to that of the tributaries of a great river The drainage area would represent the tissues of the body The water seeping through the soil would be the lymph moving past the cells Just as the ground water is collected into tiny streams, and as these unite with each other to form large ones which finally make a great river, so the lymph which surrounds the cells is collected into tiny tubes which unite to form ever larger streams, until finally they all empty their contents into the blood

Wherever there are living tissues of any appreciable size or thickness, lymph must be supplied to them It might seem, for example, that since the blood flows through the heart, its tissues would be able to get all the oxygen and nourishment they need directly from the blood constantly flowing through it However, this is not the case The heart walls are thousands of cells thick, and only the cells forming its membrane lining, and those close to it, are able to make use of the blood which moves through it on its way to other parts of the body Consequently there is need of a circulatory system in the walls of the heart itself, and we find that such a system exists It is called the *coronary system* Even the walls of the large blood vessels have small blood vessels in them It is only by this means that the cells of which these blood vessels are composed are able to get oxygen and nourishment

At certain places in the lymphatic system there are what are called *lymph nodes* or *lymph glands*, which are composed of special cells known as *lymphoid tissue* A type of white cell, the *lymphocytes*, is manufactured in the lymph nodes. Its exact function is not clear although it is believed to be a part of the mechanism which enables the body to combat certain infections.

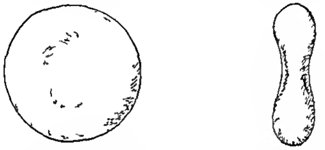
The lymph nodes help to check the spread of certain bacteria throughout the body, for example, those causing skin infections such as boils and carbuncles If a person has an infection of the finger, the nodes under the arm may become swollen and tender This means that the infection has traveled from the finger to the armpit and has been checked there by the lymph nodes If it were not for these lymph nodes there would probably be a generalized infection of the blood stream, known as *septicemia* or blood poisoning, whenever an individual suffers from a boil Groups of these nodes are present in the neck, groin, armpits, and in many other places in the body Whenever one or the other of these places is swollen and tender it is evidence of some infection These symptoms should be taken as warnings of the need of rest to assist the bodily forces upon which recovery from the infection depends If bacteria pass these defensive mechanisms and establish a generalized infection, the condition assumes a much more serious aspect

The blood The blood is a moving tissue It consists of a fluid, called *plasma,* together with almost countless numbers of cells which float in it *Serum* is the clear fluid part of the blood that separates from the red cells after the blood has left the body and has clotted It has much the same composition as the plasma except that it lacks the substances which bring about clotting

Blood cells Blood cells are of two types, red and white The white cells are not nearly so numerous as the red cells, the proportion is about eight hundred red cells to every white cell In the blood of the average healthy person there are about five million *erythrocytes*, or red blood cells, in a cubic millimeter, which is about the equivalent of a drop of blood

The erythrocytes are the oxygen carriers. They owe this ability to a constituent called hemoglobin, which is a protein that contains iron and has a chemical affinity for oxygen, with which it enters into a loose chemical combination, forming oxyhemoglobin (See page 146) There is also always some dissolved

oxygen in the plasma Because of certain physical laws of pressure and tension the oxygen is constantly being drawn off through the walls of the capillaries into the lymph surrounding the cells, which, in their turn, constantly extract it from the lymph As the oxygen content of the plasma is lowered, the oxyhemoglobin gives up some of its oxygen to the plasma Since all of the blood circulates through the lungs at least once every minute, the hemoglobin is steadily replenished with oxygen



Erythrocytes are biconcave disks The mature erythrocyte contains no nucleus

When viewed singly, the erythrocytes are not red in color, but straw colored When they have their full load of oxygen they give the blood its bright red color, when they have given up their oxygen and taken on some carbon dioxide, they appear purplish This is the reason why the veins which can be seen through the skin in some parts of the body are bluish

The erythrocytes are manufactured in the marrow of bones (See page 109) The period of existence of any particular erythrocyte in the blood stream is limited to about three weeks Hence every day many millions of these cells are liberated from bone marrow to take the place of those that are worn out and destroyed The old cells are disintegrated by phagocytes in the liver and in the *spleen*, which is located on the left side of the upper part of the abdominal cavity and acts as a reservoir for blood Another of its major functions seems to be the destruction of outworn red cells In the destruction of these erythrocytes

most of the iron and organic constituents of the cells remain in the body to be utilized over and over again

The white cells of the blood are not of uniform function and appearance like the erythrocytes The leucocytes, which constitute about three fourths of the white cells, possess the power of independent movement and are attracted in large numbers to places where infections occur (See page 80) Because of this characteristic they are able to migrate out of the blood stream between the cells composing the capillary walls The average number of white cells in a cubic millimeter of blood is from 6 000 to 8,000 In cases of acute infections, such as may occur in appendicitis, the total number of white cells is materially increased, even up to 20,000 or more per cubic millimeter Sometimes the number of these cells may be much lower than the average count of 6,000 For example, this decrease occurs in typhoid fever, influenza, and certain other diseases. This characteristic may aid in making a diagnosis of the disease

Blood plasma The plasma consists of about 90 per cent water in which are dissolved a considerable number of substances. Among the materials present in it are the absorbed products of digestion, hormones, antibodies, oxygen, carbon dioxide and other waste products resulting from metabolic activities, and many other substances. There is also a substance in the plasma, *fibrinogen*, from which fibers are produced which form a blood clot when the blood escapes from the blood vessels. If it were not for the ability of the blood to clot when exposed to the air, even a slight wound would result in continuous loss of blood until the victim bled to death

Hemophilia is a disease characterized by a marked inability of the blood to clot, because of a lack of fibrinogen. There are certain unfortunate individuals, known as "bleeders," whose blood is so poor in fibrinogen that they are in danger of bleeding to death whenever they have a slight cut to which the normal person would pay little attention. The extraction of a tooth is for them a very serious operation. This disease is one of very few that are

inherited It has attracted considerable attention, partly because of its presence in some of the royal families of Europe It constitutes an example of what are called *sex linked characteristics*, that is, its inheritance is conditioned by sex Hemophilia attacks only males, but it is transmitted by females A child may inherit the disease from a grandfather, and it may be transmitted in the germ plasm, or ova, of the mother, although she herself does not actually have the disease

Hemorrhage A hemorrhage, or loss of blood, may be caused in a number of ways It is a common occurrence in many advanced cases of pulmonary tuberculosis, in growths of various kinds, at childbirth, and in certain diseases such as hookworm disease, in which there is a bleeding from the inner walls of the intestinal tract A hemorrhage is especially significant during pregnancy and it should always receive the prompt attention of a physician The loss of blood characteristic of *menstruation*, or the regular monthly flow of women, is a normal procedure and becomes abnormal only when it is excessive If the period is prolonged much beyond the usual time, a doctor should be consulted On the other hand, any discharge of blood from the reproductive organs of a woman after the *menopause* when menstruation has ceased, should always receive prompt medical attention It is a symptom of an abnormal condition which may prove to be cancer

It is estimated by most authorities that from 5 to 7 per cent of the body weight is blood This means that there are from about nine to eleven pounds of blood, or somewhat more than a gallon, in an individual weighing in the neighborhood of one hundred and fifty pounds Persons usually recover from hemorrhages that involve as much as two fifths of the total volume of their blood It is evident, therefore, that the body has remarkable recuperative ability to make good such loss

Blood groups When a hemorrhage is severe, it is frequently advisable to use some method of increasing the amount of fluid in the blood Too small a quantity of blood does not offer

enough resistance to the heart to keep it working and, therefore, it may fail Blood from another person may be injected into the body or, failing an appropriate donor, a saline solution may be used to increase the volume

A sick person may have acute need of fresh supplies of blood for reasons other than severe hemorrhage He may be suffering from a serious infection or from chronic *anemia*, a condition characterized by too few erythrocytes or an insufficient quantity of hemoglobin It is possible in some cases to meet this need by means of *blood transfusion*, that is, the injection of the blood of one person into the veins of another

Formerly this procedure was quite dangerous for reasons that were not understood Then certain principles of immunity were discovered and applied to this field of work, and the whole procedure became simple and safe It is now known that there is a clumping, or agglutinating, of the red corpuscles of either donor or recipient in blood transfusion, unless their bloods fall into certain compatible groups As a result of the study of this kind of agglutination, which may occur in blood transfusions, it has been found that the blood of human beings may be classified into four groups With one exception, the blood of any one group acts as a foreign substance when mixed with the blood of another group It is the antigen antibody principle that operates here, as in immunity Therefore, the blood of a donor for a blood transfusion must be in the same group as that of the recipient The exception is one blood group which can safely be used for any transfusion and its possessors are known as "universal donors" About 40 per cent of human beings have this kind of blood

Blood groups are hereditary This fact is sometimes the basis for the settlement of disputes of questionable parentage, since a child and at least one parent must have blood belonging to the same group

Blood tests There are a number of blood tests which are commonly used to help diagnose certain abnormal conditions Among these is the counting of leucocytes This test is useful in deter-

mining whether there is a focus of acute infection in the body, such as may occur in cases of appendicitis, pneumonia, and many other so called *pyogenic*, or "pus producing," diseases (See page 98)

It is also helpful in certain conditions to make a count of the erythrocytes To make this test a small quantity of blood is greatly diluted with *normal salt solution*, which consists of water with an amount of salt in it equal to the percentage of salt in the blood, approximately 0 7 per cent It is necessary to use just the proper amount of salt in solution in order that the erythrocytes may not be destroyed A measured amount of the diluted blood is examined under the microscope and the number of red blood cells is counted It is possible by mathematical computation to determine the approximate number of erythrocytes in a cubic millimeter of the patient's blood This test is useful in the diagnosis of anemia and many other diseases

There are numerous other blood tests, among which is the complicated one for syphilis, known as the *Wassermann reaction* Another one for syphilis is the *Kahn test* There is also a test for determining the time it takes the blood to clot This test is usually made before operations Another very valuable test in diagnosing certain diseases is the *sedimentation test*, or the length of time required for the red blood cells to settle in a measured column of blood

An interesting microscopic test which is used in cases where it is suspected that a person may have typhoid fever, consists in mixing some of the patient's serum with a culture of living typhoid bacilli If the test is positive, the bacilli, which at first move around in the fluid, will be seen to gather together in little groups and remain motionless This is called the *Widal*, or agglutination, test This reaction occurs in the second week after infection Since typhoid fever is sometimes difficult to diagnose, and since it is a rather prolonged disease, the Widal test has proved extremely useful

Anemia Anemia as we have stated, is a condition that is the

result of too few erythrocytes in the blood or too low a hemoglobin content in the erythrocytes There are the simple, or secondary, anemias and a much more serious type called *pernicious anemia*

The secondary anemias may result from inadequate diet, acute or chronic infections, from hemorrhage, and from many other causes Diets which contain inadequate supplies of vitamin C and iron may cause anemia The anemic condition in scurvy is due to the lack of vitamin C in the diet and may be cured by eating foods that contain it (See page 181) Pregnant women and nursing mothers are very likely to be anemic, since excessive demands are made upon their supplies of iron Their diets should be rich in foods containing iron as well as calcium (See page 176) Anemia usually follows prolonged illness of almost any kind It is usually present in malaria, hookworm disease, cancer, Bright's disease and syphilis Prolonged bleeding from *hemorrhoids*, which are swollen veins in the rectum, or from excessive menstruation are causes of anemia A severe hemorrhage will, of course, deplete the blood supply and cause this condition

Pernicious anemia is due to the failure of most of the erythrocytes to mature properly They stop growing while still in the primary stage of development It has been found that there is a substance in the walls of the stomach that stimulates the development of the red cells This is called the *antianemic principle* It has not yet been isolated but has been discovered by its deficiency When it is lacking pernicious anemia results The antianemic principle has been found to be abundant in liver One of the outstanding medical discoveries in recent years is that the feeding of liver extract can be used in many cases to combat pernicious anemia successfully Previous to this discovery the disease was always fatal

Malaria Malaria is a disease of the blood caused by a protozoon which is spread by the bite of an infected mosquito of the anopheles variety Since the female alone bites, she is responsible

for spreading the disease Since the protozoon destroys the erythrocytes, malaria is always characterized by anemia

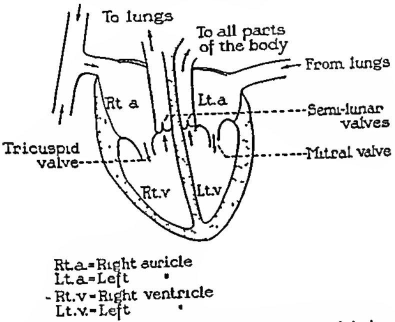
When an anopheles mosquito sucks some of the blood of a malarial victim, the microorganisms enter into its stomach with the blood The parasites develop in the stomach wall and then pass into its circulatory system, finally reaching its salivary glands There they rest until the mosquito bites another individual An interval of from ten to fourteen days is required fot the development of the parasites in the mosquito When a person is bitten by an infected mosquito, some of its saliva, which contains the microorganisms, is injected into the victim's blood Aftet gaining access to the human body the parasites for a time live in the plasma and then make their way into the red blood cells, where they multiply

Quinine is used to destroy the malarial parasites The chills and fever keep recurring at definite intervals every few days, the length of time between the attacks varying with the patticular type of malaria from which the individual is suffering The chill occurs just at the time when great numbers of the red blood cells are ruptured by the parasites which have been living and reproducing in them

Absolute immunity to malaria does not exist, although it is thought that some degree of immunity may result from successive attacks Good physical condition and, particularly, an adequate food supply may help the body to resist it and to recovet more quickly Malaria is very prevalent in many parts of the world and causes greater destruction of life and health than any other disease Major preventive measures are (1) destruction of the breeding places of anopheles mosquitoes, (2) screening to prevent their entrance into homes, aod (3) the examination and treatment of suspected sufferers The history of the investigations which were carried on to determine the cause of malaria and how it is spread, constitutes one of the most interesting and significant chapters in the field of disease prevention

III. THE HEART

The heart, its structure and functioning. The heart is the pump which keeps the blood circulating. It is slightly larger than, and about the shape of, one's fist and is situated in about the middle line of the chest cavity. It is cone-shaped, with the apex pointing



Diagrammatic representation of the principal structures of the heart.

downward and toward the left. It is generally thought to be on the left side of the body because at every beat its apex moves a little and this can be felt as it hits against the inner wall on the left side of the chest.

The heart is held in a bag, composed of tough tissue, called the *pericardium*, the inner lining of which secretes a watery fluid. The pericardial fluid acts as a lubricant, reducing the amount of friction resulting from the movement of the heart. In the disease known as *pericarditis*, the pericardium is inflamed and too much pericardial fluid may be produced. At times it

may even become necessary to withdraw some part of this fluid

The heart consists principally of muscular tissue, although there is also some fat around it Viewed from the exterior it appears as a strong muscular organ with two parts at the top, one on either side, which have somewhat the appearance of ears and hence are called *auricles* Connected with it from above are several large blood vessels

In its interior the heart consists of four chambers The two lower ones are surrounded by thick muscular walls and are called *ventricles* The upper ones, the auricles, have relatively thin walls The heart is divided vertically into two halves, a right and a left, by a partition of muscular tissue There is normally no connection between these two parts after birth Occasionally a baby is born—it is commonly called a 'blue baby' —in whom the wall of tissue between the auricles has not completely closed Such a baby actually has a bluish appearance since the oxygenated blood in the left auricle mixes with the blood of the right auricle that is rich in carbon dioxide If this partition does not close soon after birth, the infant dies Although this condition is uncommon nevertheless for the greater part of the prenatal period the auricles are not completely separated from each other

Ventricles are the pumping chambers and auricles the receiving ones The blood flows into the auricles from large veins and reaches the ventricles through the *auriculoventricular valves* The valve on the right side of the heart is called the *tricuspid valve*, the one on the left, the *mitral valve* The contraction of the ventricles forces the blood out of the heart through two large blood vessels on the right the *pulmonary artery* and on the left the *aorta* Under normal conditions the blood cannot return to the auricles from the ventricles because of the closing of the valves at the times when the ventricles contract

From the right ventricle the blood is pumped to the lungs This blood is rich in carbon dioxide In the lungs it loses most of this gas and becomes oxygenated (See page 146) With its load

of oxygen it comes back from the lungs through the *pulmonary veins* to the left auricle The part of the circulatory system through which the blood passes on its way to, through, and from the lungs is called the *pulmonary circulation*

From the left auricle the blood flows into the left ventricle and from there it is pumped with its supply of oxygen to tissues all over the body As it flows through the tissues it gives up its oxygen and receives carbon dioxide through the walls of the capillaries The blood, poor in oxygen and rich in carbon dioxide, returns through the veins to the right auricle, from which it passes to the right ventricle, and from the right ventricle it is again pumped to the lungs—and so on in a never-ending circulation as long as the life of the individual continues The circulation of the blood throughout all parts of the body, except the lungs, is called the *systemic circulation*

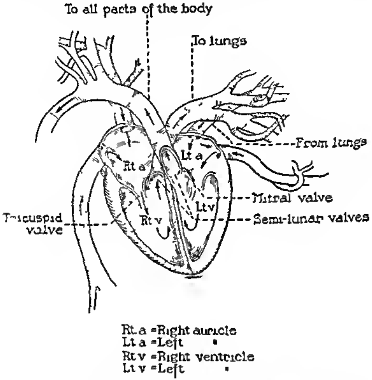
The interior walls of the chambers of the heart are lined with cells which form a membrane called the *endocardium* The endocardium, like the inner lining of the pericardium, may become infected and inflammation may develop, causing the disease *endocarditis* which is the most frequent cause of valvular disease of the heart.

It may at first seem strange that an organ which works as hard as the heart does not wear itself out in a short time The reason why this does not occur is that the heart actually is not working all the time In fact, its resting periods are somewhat longer than its working periods Although it contracts or beats on the average about seventy to eighty times each minute throughout one's life, it rests between every beat The contraction period of the heart is known as the *systole* and the relaxation period the *diastole*

During the time that the auricles are filling with blood and emptying their contents into the ventricles, the ventricular walls are relaxed and this period is a longer time than that occupied by their contraction

Let us see a little more in detail just how the heart functions.

Let us begin by examining the heart at the time the ventricles are filling with blood. During this time the auriculoventricular valves are open and allow the blood to move from the auricles to the ventricles. There is a gentle contraction of the auricular walls.



Longitudinal section of the heart, showing the relationship to blood vessels. (Illustration after Sobotta)

When the ventricles are filled their walls contract with a good deal of force. They both do this at the same time and this action results in closing the auriculoventricular valves and in opening the valves to the large arteries through which the blood moves away from the heart. At the entrance to each of these arteries there are three strong valves which prevent the blood from returning to the ventricles immediately after their contraction. These valves, because of their resemblance to half-moons, are

called *semilunar* When they are closed they form a cup which prevents the blood from returning to the ventricles

There would be no need of valves in the arteries directly connected with the heart, if the blood that is pumped out from it left with such force as to result in emptying the arteries near the heart However, this is not the case During life the parts of the pulmonary artery and the aorta near the heart are filled with blood all the time To have a conception of what happens to these arteries at every contraction and relaxation of the heart it must be understood that their walls are thick and elastic and that they dilate with every heartbeat Since they are elastic they contract after each heartbeat, with the result that some of the blood is forced back toward the ventricles, whereas the blood farther along is pushed forward through the circulatory system

Defects in the valves of the heart From this description of the action of the valves of the heart it is easy to understand the significance of any condition that impairs their functioning The efficiency of valvular action may be lowered in one of two ways, either of which may result from endocarditis Because of a thickening of the valve, the opening between the auricle and the ventricle may become so small that the blood, unable to pass through it in sufficient amount, is held back in the lungs and in the veins of the body This condition is called *stenosis* and is particularly apt to occur to the mitral valve On the other hand, a valve may be damaged in such a way that it cannot close tightly and therefore the blood escapes or leaks through it This condition is known as *incompetence* If a semilunar valve is affected, some of the blood which has just passed out of the ventricle returns to it and must be pumped again If an auriculoventricular valve leaks, some of the blood returns to the auricle upon the contraction of the ventricle instead of moving out into the artery as it would in a normal condition In either case the heart is forced to do an extra amount of work for it has to pump some blood a second time The valves on the left side of the heart are more apt to be injured since they are under a greater strain,

because the left side of the heart does more work than the right side

A heart which is suffering from either stenosis or incompetence often establishes what is called *compensation* The chamber especially affected by the leaky valve becomes dilated to take care of the greater volume of blood remaining in it, and the heart is enlarged and develops greater power to expel blood Compensation may be effective for a long time and the possessor of this type of heart may have a reasonable degree of good health for years, provided he takes good care of himself However, the fact remains that a vital organ is defective and cannot undergo strains as successfully as a healthy heart Scarlet fever, diphtheria, tonsillitis, and rheumatic fever often result in a damaged heart, a sufficiently good reason for making every effort to prevent them A very serious form of valvular trouble may be caused by syphilis

The rate of the heartbeat The rate at which the heart contracts varies with age, sex, the amount of activity, and the general condition of the individual Before birth the heart beats much faster than at any other period of one's life A month or so before birth it beats approximately 140 to 150 times per minute The average rate of an adult man is 72, of a woman 80 In the female it beats on the average a little faster than in the male and this difference in rate persists throughout life The rate of the heartbeat gradually decreases with age The heart beats more rapidly when one exercises than when one is standing still It beats faster when one is standing than when he is sitting and when he is sitting than when he is reclining

In the fever that accompanies most illnesses, the rate is usually much accelerated The extra work given the heart under such circumstances may become a serious strain upon it It may be permanently weakened if during convalescence from a serious illness, a patient is active when the heart needs to recuperate from its extra exertion during the illness The only effective way of resting the heart is by lying down

Various emotions may also cause the heart to work faster Usually we are not conscious of its activity but we have all been made to realize its loud thumping when we have been excited or frightened Its increased action at such times is owing to a greater amount of stimulation by the nerves that regulate the rhythm, or regularity, of its contraction and relaxation

The pulse The *pulse* is produced by a wavelike movement which passes along the arteries after every contraction of the heart It takes about one tenth of a second for it to reach the wrist The pulse may be tal en by pressing the fingers upon the inner and thumb side of the wrist Every time this wavelike movement is felt it means that the heart has contracted By counting these pulsations during a given interval of time it is possible to determine the rate of the heartbeat It is interesting to take the pulse before and after exercise for then it can be readily seen how exercise increases the heart s activity

The rate of the heartbeat varies with different individuals Thus two persons may have perfectly normal hearts and yet one may beat only about 60 times per minute and the other 90 The tone of the heart muscle of a person in good physical condition is healthy, and for that reason his heart tends to return more rap idly to a slower rate after exercise than it does when he is run down or has been ill

The stethoscope One of the most common instruments used by doctors is the *stethoscope* a device for listening to sounds within the chest By it the trained ear of the physician can de tect certain abnormal conditions of the heart as well as of the lungs and air passages The normal heart sounds are sometimes described as lub dub—lub dub, and they occur at every heart beat If the valves do not close properly, there will be an irregu larity in this sound One type of irregularity is called *heart mur mur*, which may be due to a leakage of one or more of the valves The stethoscope clarifies the sounds caused by the beating of the heart and also aids the physician to hear the soft blowing noise made by the passage of air through the respiratory tract

The first crude stethoscope was used by Laennec, a young doctor of Brittany who lived in the early part of the nineteenth century He was examining a fat girl in a hospital in Paris and the thick layer of fat made it difficult for him to hear the sounds in the girl s chest Up to that time the only method a doctor employed to listen to the sounds in the body was that of applying his ear directly to the chest walls of the patient This particular patient made the doctor's task more difficult because, probably from modesty, she drew away from him whenever he attempted to make a diagnosis

Shortly after this incident, as Laennec happened to be taking a walk through a court-yard, his attention was drawn to a group of youngsters some of whom were amusing themselves by listening to a tapping at one end of long pieces of timber One boy would tap on one end of a beam and another would listen with his ear against it at the other end Laennec returned to the hospital and rolled some stiff paper into a tube, one end of which he applied to the patient s chest and the other to his own ear He found that he could easily hear sounds in her chest From this crude device the stethoscope came into existence Later he made a stethoscope of wood and gradually the instrument has been perfected

The effects of stimulants and narcotics upon the heart A *stimulant* is a substance which causes an increase of activity in an organism, a *narcotic* produces a deadening effect Since the initial effects of alcohol and tobacco increase the rate of the heartbeat it might appear that they are stimulants They are, however, both classed as narcotics The reason for so classifying them can only be understood when we are acquainted with the factors which control the rate of the heartbeat Important among these factors are the effects of certain nervous stimuli which constantly travel toward the heart There are two kinds of nerves conducting these stimuli one, the ***accelerator nerve***, acts as a whip upon the heart and the other, the ***depressor nerve***, holds it in check It is due to a nice balance between the effects produced by these nerves

that ordinarily the heart functions effectively, not beating too fast and not too slowly

It is evident that the rate of the heartbeat is increased if the accelerator nerve is stimulated or the depressor nerve is deadened. Alcohol and the drug, *nicotine*, in tobacco act by deadening the depressor nerve If its efficiency is lessened, the heart is no longer held in check to the same extent and beats more rapidly Thus what appears at first glance to be a stimulating action is found in reality to be the result of a deadening effect.

Tea and coffee, however, are true stimulants. They contain a drug, *caffeine*, which activates the accelerator nerve In moderate amounts they do little or no harm to most people but their effects differ with different individuals. A wise person will be guided in the amounts used by noting the particular effects upon himself Some people are better off not to use them at all Their use by children is undesirable, if for no other reason than that they have no nutritive value and often spoil the appetite for nourishing food such as milk

Types of heart disease Heart disease is listed today as the greatest single cause of death in the general population. It occurs more frequently in middle aged and old people than at other periods of life, but since it is frequently of an insidious nature and since many types of heart disease may either be prevented or postponed through hygienic living, it is a subject of universal interest. Furthermore, although heart disease as a cause of death does not rank first below the age of about 45 years, it causes a considerable number of deaths in children, young people, and in those of early middle life. In our discussion of the disease we shall refer only to the most common types.

Heart disease is not a specific type of disorder It takes many forms, some of which have already been mentioned, as for example, endocarditis, pericarditis, and valvular deficiencies. Among the most common of its causes is syphilis which, it is estimated, is responsible for at least 10 per cent of all cases.

The most common cause of heart disease in the early years of

life is *rheumatic fever*, which usually starts with a sore throat or tonsillitis caused by a streptococcic infection It then may attack the joints, and a persistent fever appears which frequently lasts for weeks The victim recovers from the rheumatism but the heart may be permanently injured *Rheumatism* is the name given to a rather wide variety of disturbances that manifest themselves as inflammations in joints or muscles They are caused by poisons which get into the blood stream Poor living conditions and probably hereditary tendencies are among the factors which may predispose one to rheumatism Malnutrition is frequently associated with this disease Some authorities claim that vitamin C is of special importance in helping to give protection against rheumatism

In secondary schools and colleges, where competitive sports are particularly popular, the physical examination of those participating in such activities should include an examination of the heart A few students will be found to have some weakness of the heart and these should not be permitted to engage in competitive sports It frequently happens that only temporary exclusion is necessary since most heart weaknesses in youth are outgrown Thus a rapid heart, known as *tachycardia,* is rather common among young people, but usually disappears in a few years In such cases it is found frequently, upon re examination of the heart, that the condition was only temporary Sometimes the apparent heart weakness is due to simple causes such as lack of rest, poor food habits, mild anemia, overindulgence in cigarettes, etc

Care of the heart Many persons worry unnecessarily about their hearts Perhaps this is because of the fact that at times we are conscious of its activity, although most of the time its functioning is carried on without our being aware of it We come to feel that there must be something wrong with an organ like the heart, if its activities can be felt or observed Of course, this is not necessarily true. Perhaps we worry because a member of our immediate family died of heart disease and we are afraid of

inheriting it, although authorities affirm that it is not inherited Again we may have pains in the general region of the heart and consider them symptomatic of heart trouble Then one may have a "rapid" heart or a "slow" heart or may actually have suffered from a heart weakened as a result of disease or from foci of infection in the body Perhaps next to constipation the condition of the heart causes the greatest amount of fears and worries

If you think you have heart trouble, consult a physician and learn the truth In fact, the desirability of checking the condition of the heart from time to time constitutes one of the basic reasons why periodic health examinations are desirable In the majority of cases of defects or abnormal functioning of the heart, a little forethought and intelligence in following a hygienic regimen of living are all that are needed to insure a life of normal length and usefulness

It is true that there are certain individuals who should limit their activities because of some form of heart trouble, nevertheless it is a matter of common knowledge among physicians that a great many people have heart trouble only in their imaginations Such an illusion may seriously handicap them and may actually contribute to their having such trouble later in life, since it may cause them to limit their activity in undesirable ways. Often their supposed heart trouble is due to foolish unhygienic habits that may be corrected readily.

IV. THE BLOOD VESSELS

The blood vessels The largest arteries are those connected directly with the heart These break up into smaller tubes which in turn subdivide until they become so small as to be microscopic The smallest arteries, called *arterioles,* are connected with the capillaries which are so small that the erythrocytes move through them in single file These very minute tubes unite with each other to form the *venules,* the smallest veins, and these in turn unite to form larger veins, the largest of which are the *superior*

and *inferior venae cavae* which empty their contents into the right auricle The blood flows from the lower part of the trunk and from the legs into the inferior vena cava and from the arms, shoulder region, and head into the superior vena cava

The blood flows most rapidly in arteries Its movement is slowest in capillaries This is because the total area of the inner walls of the capillaries is much greater than that of the large arteries or veins The rate of the blood flow is proportionately slower as the total area of the tubes through which it flows becomes larger When the blood leaves the capillaries and enters the veins it again flows more quickly, as the total area of its tubes becomes less

The arteries contain a considerable amount of elastic tissue The walls of the arterioles are made up largely of muscular tissue by the contraction of which their *lumens*, or bores, are made smaller The walls of the capillaries are only one cell in thickness, so that osmosis readily occurs through them (See page 222) It has been estimated that if the capillaries in the body of a single adult were placed end to end they would extend a distance of over 60,000 miles, or two and a half times around the earth

The veins have some elastic and muscular tissues in their walls Some of them also have valves which open in a direction toward the heart and thus help to prevent the blood from either stagnating in the veins or actually flowing back into the capillaries

Varicose veins In varicose veins these valves are broken down, and hence the blood tends to accumulate in them and cause them to swell Varicose veins frequently occur in the legs just under the skin Sometimes a serious hemorrhage may result from injury to them They can be treated by a supporting bandage or by injections of a solution which will block their openings, thus preventing circulation in them Since the deeper veins in the legs maintain a normal functioning, no real injury results Varicose veins may also occur in the lower part of the rectum They are then called hemorrhoids, or piles The usual cause is chronic constipation, and is owing to the pressure of the unemptied rec-

tum and excessive straining of the muscles during defecation Because varicose veins are caused chiefly by stagnation of the blood, they are liable to occur in people whose occupations require them to stand continuously Such people should make an effort to move around often since activity of the legs promotes a freer flow of the blood in them

Factors controlling the flow of blood The circulation of the blood in the body is automatic There are a number of factors that influence it Some of them—age, exercise, illness, emotions—have already been considered in relation to the functioning of the heart Since there is not sufficient blood in the body to fill all the blood vessels at any one time, and since the need for blood in different organs is not always the same, it follows that some kind of mechanism for regulating the flow of blood to meet the varying needs of the body is essential This need is met, in part, by the activity of certain nerves which automatically change the bore of the arterioles, the walls of which, as we have just stated, consist largely of muscular tissue If in any part of the body the arterioles contract and other conditions remain constant, a diminished supply of blood passes through the arterioles in those regions Certain nerves, when stimulated, cause the arterioles to dilate and other nerves carry impulses that make them contract. The former are called *vasodilators*, and the latter *vasoconstrictors*

Blushing and turning pale are examples of the effects of the automatic changes which may occur in the size of the arterioles in the face After a meal those in the various parts of the digestive system tend to be dilated During exercise the arterioles through which the blood flows to the skeletal muscles are enlarged When one is exposed to cold there is a tendency for those which lead to the surface of the body to contract and in a warm place the opposite type of reaction occurs in them

In fainting the arterioles connected with the capillaries in the brain are constricted If one feels faint he should lie down if possible, if he is sitting, putting his head between his knees will help Either position will result in causing more blood to flow

to the brain and usually will prevent losing consciousness When a person has fainted his body should be placed in a horizontal position and the clothing around his neck loosened to permit of a free circulation of the blood to his head

Blood pressure When the ventricles contract and expel blood, they use a certain amount of force, they meet with a certain amount of resistance, and the expelled blood exerts a certain amount of pressure upon the walls of the blood vessels The amount of pressure exerted is determined by the force pushing the blood from behind and the resistance that it meets in front The force needed depends on the volume of blood that must be discharged to meet the particular needs of the body at any given time and the resistance against the blood flow that it must overcome in the arterial system The resistance is caused by friction between the blood and the walls of the arteries, and by the diminishing size of their bores The chief resistance is met in the arterioles and the capillaries

The pressure of the blood upon the walls of the blood vessels varies normally with such factors as age, sex, emotions, exercise, rest, and the general health It can be measured, and the large artery in the upper arm is usually used for the purpose The instrument employed is called the *sphygmomanometer* It registers the systolic pressure, that is, the highest pressure attained by the contraction of the heart

The blood pressure should be taken in every thorough physical examination. There is a rather wide range of variation within the normal in blood pressure as well as with the rate of the heartbeat In spite of this variation the doctor finds that a determination of the blood pressure is helpful in assisting him to diagnose certain abnormal conditions of the heart, blood vessels, and kidneys

Like the stethoscope, the sphygmomanometer has an interesting history The first attempt to measure blood pressure of which there is any record was made by an English curate, Stephen Halles, who experimented with horses He tied the large artery

in the leg of a horse to a metal tube with which a glass tube of about the same bore as the artery was connected. He found that there was sufficient pressure in this artery to force the blood a distance of somewhat over eight feet above the horse. After his time mercury was substituted for blood and the height of the column of mercury which was maintained by the blood pressure became the means of designating its force. All this early work was done with animals. It was not until about the middle of the nineteenth century that a device for measuring human blood pressure was invented.

In 1896 the sphygmomanometer, in practically the same form that it is used today, was first demonstrated by a physician. This is a cuff of rubber tubing which is wrapped around the upper arm and which is also connected with a mercurial registering instrument known as a manometer. The amount of pressure which is exerted by the air that is forced into this instrument may thus be measured. The doctor forces air into the rubber cuff and at the same time listens with a stethoscope to determine when the blood supply is cut off from the artery just below where the pressure is applied. By taking careful note of just the amount of pressure needed to cut off completely the flow of blood through this artery he is able to determine the blood pressure at any given time.

Arteriosclerosis. Arteriosclerosis is a condition in which the walls of the arteries have undergone a greater or less degree of "hardening" owing to a deposition of lime salts. The inner coat of the arteries gradually becomes thicker and rougher with the result that their bores grow smaller. Those in the heart, kidneys, and brain are especially apt to become hardened, although usually not all of these organs are affected in one person.

Several possible explanations as to how arteriosclerosis may originate have been advanced, but there appears to be no single cause that is present in all cases. Heredity is a predisposing factor in producing the disease in some people. The arterial walls may be of poor quality and so become diseased more easily. There is

a tendency among the great majority of people to develop this condition as old age approaches, and it is well known that it often appears in conjunction with high blood pressure, heart disease, and kidney disease However, the arteries of all old people are not affected and those of young people may be Poor heredity in combination with certain types of infections, muscular strain, worry, and sedentary living may reduce the tone of the blood vessels and contribute to arteriosclerosis Chronic alcoholism and syphilis are definitely known to be causes

High blood pressure and an enlarged heart usually accompany arteriosclerosis The narrowed openings of the arteries offer a greater resistance to the flow of blood, which raises the blood pressure and puts an extra burden on the heart That organ compensates by doing more work and growing larger When arteriosclerosis affects the arteries of the kidneys, which are especially rich in blood vessels, their functioning is disturbed

Apoplexy is the condition resulting from the rupture of a blood vessel in the brain and is caused in large measure by arteriosclerosis When arterial walls become brittle they lose much of their elasticity and hence are more apt to rupture under high blood pressure After an artery in the brain breaks, the blood which escapes forms a clot which presses upon the neighboring tissues This pressure interferes with the normal functioning of the brain and the usual result is a paralysis of certain muscles of the body This paralysis is, in part, because of the fact that there are areas of the brain which contain nerve cells the functioning of which makes possible various bodily movements If these *motor areas*, as they are called, are rendered ineffective from the pressure of a blood clot upon them, the muscles of the body with which they are connected become paralyzed

Sometimes the first attack of apoplexy is fatal, but more frequently the victim recovers slowly as the blood clot in the brain is gradually absorbed and the pressure removed The time it takes to recover depends to a considerable extent upon the size of the blood clot The place in the artery where the rupture occurred

is permanently weakened and frequently breaks again, the second, or possibly a third attack practically always being fatal

If a blood clot, or *thrombus*, should be formed in an artery the bore of which is already decreased in size by arteriosclerosis, the clot may block the opening with very serious results The process is called *thrombosis* Blood does not usually clot when flowing through a blood vessel If, however, a place in its walls is damaged by inflammation, its smooth surface becomes rough and minute cells in the blood, the platelets, may cling to it and a clot may be formed Thrombosis is very apt to affect a valve that has become inflamed It frequently affects the coronary arteries When thrombosis occurs in a large coronary artery the sufferer may die suddenly *Coronary arterial thrombosis* is a very common form of sudden death in elderly people Sometimes there are several attacks of this kind as different arteries are affected, or again one attack may prove fatal

A thrombus may be separated from the wall of the blood vessel and be carried in the blood stream When it is so detached, it is called an *embolus* If one is carried to a vital organ and is large enough to get caught in the bore of a main artery, it may cut off the essential blood supply This process is known as *embolism* and is one of the causes of sudden death

First aid for cuts There are two things to have in mind in case of cuts one is to stop excessive bleeding and the other is to sterilize the wound Some bleeding is desirable for it helps to make the wound sterile Ordinary cuts should be washed with boiled water or a mild antiseptic solution, using a piece of sterile gauze or cloth If clotting does not occur readily, a pad made of a sterile cloth and pressed upon the wound will generally assist in the formation of a clot This method of stopping the bleeding is usually all that is necessary even if a fairly large blood vessel has been severed

If the wound is more serious, another procedure is required. An injured artery is more dangerous than an injured vein since the arterial pressure is greater than that in the veins, and there-

fore a clot does not form so easily. However, it usually happens that both arteries and veins are cut, if the wound is of any size. If a large artery is cut, the blood comes in spurts, if a large vein is cut, it flows steadily To stop the bleeding from a severed artery, pressure must be applied between the cut and the heart, to stop it from a large vein, the pressure may be on the side of the cut that is farther from the heart If the blood is coming fast and in spurts, pressure should be applied immediately This is best done by using a *tourniquet*, which is a device for stopping bleeding A doctor should be sent for at once If the wound is in a place where a tourniquet cannot be used, as in the neck or on the trunk, pressure should be applied on the artery which is supplying the blood, with the thumbs or the ball of the hand until a thick pad can be made for the purpose

A tourniquet may be made by using a large handkerchief or some cloth and placing a hard substance like a pebble in it. The hard substance should be placed over the artery above the cut Then a stick or pencil should be placed under the cloth and twisted in such a way as to apply pressure The tourniquet should not be left on indefinitely since its application results in cutting off the blood supply to the tissues below it It should be loosened every fifteen or twenty minutes to permit some blood to flow to the tissues The wounded part should be elevated if possible For example, the arm should be raised, if a finger is cut This will result in decreasing the amount of blood that will flow to the hand and help a clot to form

Court plaster or adhesive tape should not be placed directly over a cut, but may be used to hold sterile gauze in place The air supply should not be cut off from wounds, especially those that are deep and have been made by something that has been in contact with the soil Such wounds may contain the bacilli that produce lockjaw, or *tetanus* These bacteria are *anaerobic*, that is, they grow best without air

IX

EXCRETION AND THE SKIN

1. THE SIGNIFICANCE OF EXCRETION

The excretory products The blood stream and the lymph have a two-way traffic in the oxygen and nutrients, and in the waste products, which they distribute to the cells, or carry to the organs which eliminate them from the body, as the case may be At the times when our activity is increased the speed of distribution and discharge of materials proceeds at a faster rate, and at other times, when we are resting or asleep, it is greatly reduced After the foodstuffs are delivered to the cells they are used in a variety of ways Some of the amino acids are actually built into the protoplasm itself The carbohydrates and fats are either stored or used immediately as fuel in the form of glucose Sooner or later the protoplasmic structures making up the cells are broken down and the substances resulting from their disintegration, that are not needed by the body, are eliminated

Carbon dioxide, water, minerals, and some of the organic compounds are present in the tissues and perform necessary functions They are injurious only when present in excess of need and are excreted whenever this condition occurs On the other hand, there are other products of metabolism that must be eliminated entirely or definite toxic effects will follow Most of the wastes given off by the large intestine are of this nature The glucose present in the muscle tissue is oxidized and the end products are carbon dioxide and water (See page 120) The major end product in protein metabolism is *urea*, a nitrogenous waste A small amount is normally present in the blood The excess is excreted principally by the kidneys, the skin giving off a small amount in the perspiration

The organs of excretion The primary organs for the excretion of waste products are the lungs, large intestine, and kidneys The liver and skin have excretory functions, but these are generally considered as secondary to their other activities We have already described how carbon dioxide is passed out through the lungs Unless the excretory processes are carried on efficiently, the body becomes poisoned by an abnormal accumulation of wastes

II THE LARGE INTESTINE

The large intestine The mass of undigested and indigestible material in the large intestine is called the *feces* There is considerable absorption of water from the feces, the exact amount depending largely upon the length of time it takes to move along through the large intestine In cases of constipation, where the peristaltic motions are weak or ineffective and the movement is very slow, a larger percentage of water is absorbed before evacuation occurs Roughage, food with considerable indigestible material like cellulose, makes peristaltic action more effective for it stimulates the muscles that propel the digested mass along the tube (See page 192) There are present in the large intestine innumerable bacteria which are themselves usually harmless but which, under certain conditions, may so react on food as to produce injurious toxins This may happen when an excess of protein food is eaten Generally the feces do not remain in the large intestine more than twenty hours, and frequently they stay a much shorter time Upon being passed into the rectum, the last segment of the colon, certain nerves are stimulated which create a desire to defecate Normally the feces are not retained in the rectum but are evacuated almost immediately

Constipation Constipation is a condition in which the fecal matter fails to pass through the large intestine as rapidly as it should Perhaps more than half of the adult population of the United States is either actually troubled with constipation or imagines that it is By no means everyone who believes that he

is suffering from constipation has any real cause to justify his belief People vary greatly in the number of evacuations of the bowels that normally occur in a given interval of time Some regularly have two or three a day, and others go for two or three days or even longer between evacuations Most people on the average probably have one bowel movement a day

Symptoms of constipation are hard dry stools and difficulty in defecation The effects may be headache, depression, and sluggishness The stagnation of fecal matter in the descending colon and the rectum causes discomfort and a feeling of fullness These effects are caused by pressure of the mass against the walls of the colon and to nervous stimulation It is now believed that they are seldom owing to poisons given off by the decomposition of fecal matter, for defecation relieves the effects of constipation much more quickly than the body can rid itself of any poisons present in the blood 'Autointoxication' is a much exploited term in the advertisements of the manufacturers of laxatives Autointoxication, which undoubtedly occurs at times, is due to the presence of various toxic substances in the blood that have been absorbed from the intestine It is rather rare and is not necessarily a result of chronic constipation, as patent medicine manufacturers imply

Constipation is often associated with indigestion These disorders are not specific diseases like tuberculosis and typhoid fever, they are caused rather by some functional difficulty (See page 74) A functional disorder, it will be recalled, is the result of an interference with the normal working of some part of the body without the existence of any known causative agent or any destruction or injury to the tissues involved Thus a person may have, as far as can be determined by examination, perfectly sound organs, and yet they may not function as they should The type of indigestion or constipation that is caused by tension, which may result purely from haste or worry, is a functional disorder of rather frequent occurrence.

On the other hand, there may be some organic disease, a con-

dition characterized by a visible change in the tissues, that may produce or be associated with either indigestion or constipation or both of these conditions An inflamed appendix, ulcer, or cancer of the stomach, a tumor, and a diseased gall bladder are all examples of abnormal organic conditions which may interfere with the secretion of the digestive juices and with the movement of the material through the alimentary tract If the primary trouble is cured, the accompanying difficulties are either mitigated or disappear Because of the frequent connection between indigestion and constipation and more serious disorders, a person afflicted to any extent with either of the former troubles should consult a physician for examination since intelligent treatment depends upon proper diagnosis

There are two common types of constipation In one, the large intestine is oversensitive to stimuli This is called the *spastic* type. It is characterized by irregular and ineffective movements of the intestinal walls Spastic constipation requires a smooth, soft diet with considerable bulk It is frequently associated with *colitis*, a condition involving an inflammation of the mucous membranes of the large intestine Excessive use of coarse food in the diet irritates and aggravates the inflammation

The *atonic* type of constipation, which is more frequent than the spastic type, is characterized by a lack of tone or sluggishness in the muscular walls of the intestines These two types are not always sharply differentiated The atonic type may, for example, develop into the spastic It was formerly thought that all constipation was due to a sluggish action of the walls of the large intestine, consequently everyone having constipation was urged to eat large amounts of roughage to increase peristalsis It is evident that correct diagnosis of the type of constipation is fundamental, if the condition is to be helped and not aggravated

The different methods of artificially producing bowel movements are not all equally objectionable Some are much milder than others and are not habit-forming Doctors generally agree that the habitual use of cathartics, even of the milder form, is

harmful Salts of various kinds extract water from the tissues in the alimentary tract, and this in time injures them Most cathartics irritate the mucous membrane lining of the intestinal walls If taken often enough, they cause a chronic irritation which makes normal functioning still more difficult It is especially dangerous to take a cathartic when one is suffering from abdominal pains of unknown origin (See page 214)

Some cases of constipation are very genuine and stubborn. A large percentage are the direct result of treatment with cathartics through many years By the time some of these cases reach a doctor not much can be done to remedy the condition Most cases, however, can be relieved, if not entirely cured, by employing one or a combination of the following procedures securing more exercise, adopting a more rational diet, the use of glandular extracts, the removal of a growth, an infected appendix or gall bladder, and by the use of some simple preparation such as mineral oil or agar-agar

The habit of regular evacuations at a definite time each day is both a preventive of constipation and a help in its cure The desire for defecation is apt to come most frequently soon after eating, because of the fact that more vigorous peristaltic movements occur in the digestive tract at such times The response to the desire to defecate, which occurs upon the arrival of the feces in the rectum, should be immediate, if possible The time of day for the regular evacuation can usually be, within certain limits, chosen to suit one's convenience, but it should be at the same time each day Even if the desire is lacking, one should go to the toilet at the regular time Furthermore, sufficient time should be allowed for this necessary bodily function, since a feeling of haste may cause muscular tension which may prevent evacuation

III. THE KIDNEYS

The liver as a co operating organ with the kidneys The liver is the largest organ in the body Besides storing glycogen, secret-

ing bile, and acting as a receiving station for all the digested nutrients except the fats, it prepares the major nitrogenous waste, ammonia, for excretion by the kidneys Many of the nitrogenous wastes given off by the cells in their utilization of the amino acids are changed into ammonia, which has a toxic effect on the body if present in the blood in any more than minute amounts The liver changes ammonia into urea, a form that will allow it to be eliminated by the kidneys

The kidneys As the large intestines are the organs for the disposal of the solid wastes of the body, the kidneys are the most important organs for the elimination of fluid wastes, although some water is passed out of the skin in perspiration and from the lungs in the exhaled bteath The kidneys consist of two organs about four inches long and are situated in the abdominal cavity on the level with the lower ribs, one on each side of the middle of the back They are protected with a covering of connective tissue and a layer of fat They are not firmly attached to the abdominal wall and if one becomes loosened, it is called a ' floating kidney "

They remove from the blood principally watet, salts, and urea which are eliminated from the body in the *urine* The urine is composed of from 95 to 97 pet cent water From three to four pints are passed by the average adult in good health every twenty-four hours

The kidneys are part of the *urinary system*, which consists, in addition to the kidneys, of two tubes, known as *ureters*, that connect each kidney with the urinary *bladder*, and the *urethra*, a tube which leads from the bladder to the exterior of the body Urine is constantly trickling from the kidneys through the ureters to the bladder

The kidneys contain many small tubes, or *tubules* It is estimated that there are approximately one million in each kidney After many convolutions they reach larger tubules that empty into the *pelvis* of the kidney, which drains into the ureters There are innumerable capillaries around the tubules The wastes which

make up the urine are constantly being filtered from the blood in the capillaries into the tubules from which they pass into the ureters and the bladder The amount of urine formed appears to be regulated by the amount of blood circulating in the kidneys

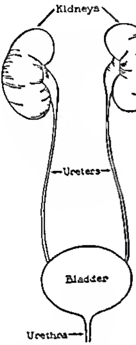


Diagram of the urinary system

In the urethra there are two muscles, called the *sphincters*, one where the urethra is joined to the bladder and the other a little lower They are usually contracted and the former muscle is involuntary The bladder is hollow and lined with a very strong muscle which stretches as the urine collects. After a certain amount has collected, the pressure becomes great enough to start a series of contractions in the muscle At this point the sphincter muscle at the opening of the bladder relaxes and releases some of the urine into the urethra The other sphincter is under the control of the will When it is relaxed, urine is voided from the body

The drinking of sufficient water assists the functioning of the kidneys With too little intake of water there is too great a concentration of solid matter in the urine, frequently producing irritation The optimum amount of water needed depends on such factors as the weather and the amount of exercise On warm days less urine is produced than in cooler weather because the skin is giving off more water in perspiration Strenuous exercise reduces the amount of water for the same reason For some hours after severe exercise the color of the urine is darker than normal because of the higher concentration of solids On the other hand, more urine than usual is formed on cold days because less water is evaporated from the skin and because more blood is flowing through the kidneys owing to the constriction of the capillaries in the skin from the cold Any water in excess of that needed by the body is eliminated by the kidneys One of their functions is to maintain the water balance of the body In general, thirst is an indication of the amount of water needed Since normally there is a body loss of about two quarts a day, it should be counterbalanced by consumption of the same amount Not all of this need be in the form of pure water since many foods have a very high water content Nevertheless, it is probably better to drink an overamount of water rather than too little Since the kidneys are the chief organs for the removal of wastes resulting from the utilization of proteins, it follows that an excess of protein food in the diet will put an extra burden on them The kidneys may also be injured by an excessive use of alcohol

Frequent *micturition*, or voiding of urine, may be owing to a number of causes The caffeine in tea and coffee and certain other drugs have a direct action on the blood vessels in the kidneys, causing some of them to dilate This effect, together with the increased heart action resulting from the caffeine, augments the circulation of the blood through the kidneys, causing more urine to be produced The amount of urine may also be increased by certain emotional reactions such as nervousness and

anxiety and, on the other hand, urination may be inhibited by embarrassment and fear

Urinalysis is made in every thorough medical examination If such substances as albumin and pus which are not normally present appear, they are an indication of possible serious bladder or kidney disease Albumin is a protein substance commonly present in urine in certain disorders It may appear as the result of a temporary condition, therefore a second analysis should be made a few days later Its continued presence would indicate some kind of diseased condition The primary cause of the trouble may not be in the urinary system It may be that the kidneys are being injured in attempting to remove from the blood bacteria and their poisons that have entered it from a focus of infection in such places as the teeth, tonsils, gall bladder, sinuses, or appendix If such foci of infection are cleared up, the kidneys usually recover from the damage, although long continued neglect of primary infections may seriously impair their functioning

If the kidneys themselves have been the foci of an active infection, or a degeneration of their tissue has occurred, the situation is much more serious, and the disease is called *Bright's disease*, or *nephritis*, which is an inflammation of the tubules of the kidneys. Its causative agent probably is of bacterial origin, but the definite organism is not positively known It is believed that an acute attack of Bright's disease may follow a streptococcal infection such as tonsillitis, scarlet fever, or septic sore throat It also may develop after a cold It may be produced by continuous use of alcohol or the absorption of lead or turpentine from paint or turpentine products The symptoms include diminished secretion of urine, albumin and certain other substances in the urine, dropsy—abnormal retention of fluid in the tissues—and, in severe cases, convulsions

Each attack of acute Bright's disease destroys some of the tubules, with the result that after repeated attacks the kidneys become permanently injured and the disease becomes chronic High

blood pressure and arteriosclerosis may accompany it As the walls of the arterioles in the tubules become thickened in arteriosclerosis, the lumens of some of the vessels close, the blood supply is cut off from the affected tubules, and they cease to function The blood pressure is increased because the remaining tubules must excrete more and more waste products, and this extra demand raises the pressure The blood pressure may increase to such an extent that the heart is overstrained and the patient dies of heart failure, or a blood vessel in the brain may rupture and he dies of cerebral hemorrhage

Bright's disease may occur at any age, but it is primarily a disease of middle and later life It may occur in an acute form during pregnancy, especially in the seventh or eighth month, and this is one of the reasons why pregnant women should be under close medical supervision It ranks fourth as the cause of death in the United States, being exceeded only by heart disease, cancer, and apoplexy

IV THE SKIN

The skin as an organ of excretion The skin carries on its excretory functions through its production of perspiration Perspiration is continuously evaporating from it, although the amount is usually so small that we are not conscious of it As we have seen, the amount of perspiration excreted depends upon such factors as temperature, muscular activity, and the amount and type of clothing worn (See page 137) With a marked increase in the amount of perspiration the output of the kidneys becomes less and thirst increases This constitutes a regulatory mechanism preventing too grear a loss of water from the body Most of the water excreted is eliminated by the kidneys under ordinary conditions As an organ of excretion, therefore, the skin is of minor importance since the amount of wastes eliminated by it is small in comparison with that excreted by the kidneys

Other functions of the skin are (1) affording protection to the body against injury and pathogenic bacteria, (2) registering sensations of cold, heat, pain, and pressure, and (3) regulating the body temperature We have already studied this last function in our discussion of the heat regulating mechanism of the body (See page 137)

The structure of the skin The skin is composed of two parts The outer part, called the *epidermis*, is composed of many layers of cells Its outermost layers are flattened and without nuclei and are either dead or dying They are constantly being sloughed off and replaced by the cells beneath, which are pushed upward toward the surface As these cells approach the surface they become flattened and undergo chemical changes which result in making them horny or scalelike, and impervious to water

There are no blood vessels in the epidermis, but hairs and the ducts of the sweat glands, which are the "pores" of the skin, pass through it The coarseness or fineness of the skin texture depends upon the size of the pores and varies widely with different people The person who possesses a skin of fine texture is fortunate for if he observes the rules of hygienic living he will usually have a clear complexion The color of the skin is determined largely by the pigment granules in the lower layers of the epidermis

The true skin, or *dermis*, is below the epidermis It is made up of two layers The upper part consists of a single stratum of cells which are constantly dividing in a plane more or less parallel to the surface of the body It is from this actively growing layer that the epidermis is constantly being replenished Any cuts or breaks that are the result of ordinary accident or injury are usually healed because of the power of regeneration of this part of the dermis This regenerative layer is thrown into tiny elevations, or *papillae* Some of the papillae contain blood vessels that nourish the skin and others contain nerve endings that are sensitive to certain stimuli

The lower layer of the dermis lies below the actively growing

cells It contains many varieties of tissues among which are fatty masses, roots of hairs, roots of nails, sweat glands, oil or sebaceous glands, blood vessels, nerves, connective tissue, and some rudimentary muscle cells The roots of hairs and nails are outgrowths of the dermis and consist of dead cells that are pushed upwards and outwards The dermis is particularly well supplied with

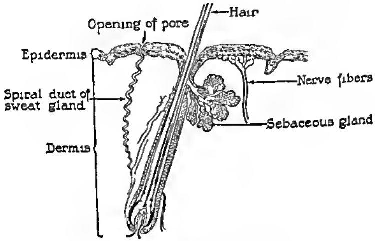


Diagram of a section of the skin, showing some typical structures (*After* Maximow Bloom, *Textbook of Histology*, W B Saunders Company)

blood vessels which, as well as the pigment, give color to the skin

The tanning of the skin takes place in the dermis and is caused by a brownish deposit from the blood When it is exposed to the sun or other ultra-violet radiations for any length of time, the blood is drawn into it in greater amounts When the blood leaves the skin it leaves behind the brownish pigment. Too long exposure to ultra violet rays destroys tissue, and tanning is a protection against an undesirable degree of penetration When exposure to the sun is gradual and the skin has had time to develop this protective coloration, the action of the ultra-violet radiations is most beneficial We have already spoken of their action on the ergosterol of the skin in manufacturing vitamin D, in this way preventing rickets in children and promoting the

general health (See page 182) Freckles appear in places where the pigment is concentrated

Protective function of the skin In its protective function the skin when unbroken is an almost perfect shield against the entrance of disease-producing organisms Because bacteria are very likely to be present on its surface, a cut or prick may allow them to penetrate to the tissues in the lower layers of the skin There they may set up an infection which may remain local, but which is sometimes the cause of general blood poisoning, or *septicemia*, if the bacteria are of the pus forming variety When there is to be a deliberate puncture of the skin, as in the giving of hypodermic injections or inoculations, or the making of an incision in an operation, the skin is always sterilized first Alcohol, tincture of iodine, or mercurochrome are generally used for this purpose In the case of an accidental cut or prick the wound should first be cleansed and then treated with an antiseptic solution

Sensory function of the skin The nerve endings in the papillae are called *receptors* and are sensitive to stimuli that make possible sensations of pain, touch, cold and heat Each kind of sensation has a different receptor These sensory spots are distributed unequally all over the body but in such a way that no region of any size is lacking in all kinds of receptors There are from two to three million pain receptors—many more than of any other kind, about half a million touch receptors, a quarter of a million cold receptors, and about thirty thousand heat receptors

The pain receptors are very generally distributed over the body, certain parts of which, like dentine, evoke only sensations of pain Pain may be felt in practically any part of the body and may be caused by stimulation of any sensory nerve—through heat, cold, or pressure, for instance—if it is sufficiently intense

Experience shows that the tips of the tongue and the fingers contain the greatest number of touch receptors per unit of area Sensations of touch are often transmitted along hairs to the re-

ceptors of touch at their roots, the hairs acting to increase the delicacy of the sense The whiskers of a cat, for example, serve to give definite warning of places too narrow for the entrance of its body

The cold and heat receptors are not usually stimulated when the temperature remains about the same, unless it is markedly hot or cold When the temperature changes, either one kind or the other is excited, the cold receptors when it is falling, the heat receptors when it is rising The temperature receptors are very adaptive For instance, when we first go into a warm room from the cold outside, we are distinctly conscious of a sensation of warmth, but in a few minutes we cease to be conscious of any temperature sensation, again, soon after stepping into a hot bath the water feels comfortably warm

It is very evident how useful these sense receptors are to the body Through them we become aware of our surroundings, whether they are favorable or harmful, pleasant or disagreeable We relax in pleasing warmth, we shiver in injurious cold, contact with dangerous objects may be avoided by the sense of touch, while pain is the warning of trouble somewhere in the body When it is experienced its cause should be sought, for it may be the danger signal of serious disorder

The hair Hair grows all over the surface of the body except on the palms of the hands, the soles of the feet, the eyelids, and a few other places The root of a hair grows from a special kind of papilla located under the *hair follicle,* or a depression in the dermis Most of the follicles have a pair of glands, the *sebaceous glands*, opening into them They secrete the oil which keeps the hair and skin soft The hairs are nourished by the blood vessels in the follicles at their roots Muscles lie alongside the follicles They seldom function in human beings, but in animals they contract and cause the hair to stand erect whenever they are angered or frightened

The color of hair is dependent upon two things the pigment in the cells and the number of air cavities in them All hairs have

some air cavities which reflect light. Dark hairs have few and hence reflect little light, whereas white hairs have many

The care of the skin and hair The skin is a good index to the general condition of the body Nothing can take the place of hygienic living in helping to maintain the skin in good condition Proper diet, adequate rest, normal bowel activity, sufficient exercise in the open air, and cleanliness are the prime essentials for a healthy skin

Bathing is fundamental to the health of the skin because it stimulates its circulation and prevents the clogging of the sweat glands by the deposit formed by the secretions of the sebaceous glands It is also important because it prevents body odors and promotes the general feeling of self respect that comes from a well cared for body

In general, there are two kinds of baths, the cleansing bath and the tonic bath which is used because of its effects upon the nerves, muscles, and circulation For the cleansing bath, water at about body temperature and soap are needed Bathing at body temperature is relaxing and restful to most people The cleansing bath should be taken at least three times a week.

The tonic bath is the cold bath, the degree of cold which is stimulating depending upon the individual It should not be taken when one is chilled or in ill health The first reaction from a cold bath is to drive the blood from the skin On emerging from the water it should be followed by the quick return of the blood to the surface of the body, producing a feeling of warmth and stimulation This reaction can be aided by a brisk rubbing with a rough towel A cold shower is the best method of taking the cold bath because it is more stimulating to the nerves of the skin Just after arising in the morning is the best time for taking it.

Because the skin of the face and hands is more exposed than that of other parts of the body, it requires special attention. Alkaline soaps should not be used on the face or indeed upon other parts of the body The face should be bathed with warm

water and pure soap at night before retiring A lather should be made and applied, preferably with the fingers unless a fresh clean cloth is used It is important to rinse thoroughly to prevent a residue of the soap remaining in the pores Cold water then dashed on the face will stimulate the circulation Unless one lives in surroundings where the air is dirty, one application of soap to the face is all that is needed in a twenty-four hour period

For one s own safety, as well as that of others, the hands should always be washed before handling food and after going to the toilet Since they are very apt to touch materials infected with harmful bacteria, the hands should be kept away from the face and the body openings The nails should never be used to scratch any part of the body since they may very readily break and infect the skin

The sebaceous glands are less active in cold weather Washing removes some of the oil they secrete, and since the evaporation of moisture also has a drying effect on the skin, particular care should be taken to dry the face and hands thoroughly in winter to prevent them from getting chapped Substances like olive oil, cold cream, or vaseline rubbed into the skin are helpful in preventing and curing chapping

Different types of clothing have pronounced effects on the skin Reference has been made previously to the effect of different textures of clothing upon the heat regulating mechanism of the body (See page 138) Tight or rough clothing may interfere with the circulation or cause irritation to the skin which may result in infection Wool, fur, or feathers may cause allergic reactions in some skins

The condition of the hair is often an index of our general health, since the hair receives its nourishment from the blood in the same way as the other parts of the body A severe fever may so injure the hair as to cause it to look lifeless and fall out in clumps On the other hand, persons in good health may have "thin" hair and become bald for no apparent reason

Bathing, sunlight and air are invigorating to the skin provided it is not overexposed (*Ewing Galloway*)

Children in cities in England are now being given ultra-violet ray treatment during the dark foggy winter months (Wide World)

The use of sun lamps in homes should be under medical supervision (Ewing Galloway)

The condition of the hair is evidence of the care and attention given to our personal appearance Bright, naturally glossy hair adds considerably to our attractiveness Its health depends, at least in part, upon its cleanliness and the stimulation of the circulation of its roots It should be shampooed with a pure soap when dirty If it has a tendency to be too dry, olive oil may be rubbed into the scalp To increase the circulation it should be brushed vigorously every day and the scalp massaged with the fingers

Cosmetics are used by many women to add to the attractiveness of their complexions They cannot cover up a pasty sallow complexion, hide a pimply skin, or take the place of healthful habits of living in helping to make the skin beautiful It is impossible to speak with much authority about most cosmetics because they have not been used long enough to learn their possible effects upon health over a long period of time Nevertheless, since cosmetics are in very general use, certain statements may be made in regard to them that may be considered words to the wise

Many cosmetics contain harmful ingredients such as lead, mercury, and arsenic, which may cause serious injury to the skin It is unwise to use any, the composition of which is unknown or, if known, the effects of which on the skin have not been determined. Some cosmetics set up special allergic reactions in some skins Certain widely known and advertised products have caused serious skin irritation and even severe toxic effects on the whole body

The price of cosmetics is usually out of all proportion to the actual cost of their ingredients, although large amounts may be spent in advertising them Lip-stick, although not harmful to most users, may cause trouble if applied to lips that are cracked. Most of the danger in the use of rouge and lip-stick is due to the presence of aniline dyes to which some women are sensitive, although apparently the majority are not.

Depilatories, or hair removers, are often not permanently effec-

tive and their use in some cases has resulted in more or less serious injury to the skin The only sure and safe way to have hair removed is by the use of the electric needle in the hands of an expert The use of freckle removers has proven harmful to some people Deodorants may injure the skin, although most of them are harmless if used upon a small area The material used to remove enamel from finger nails is apt to make the nails brittle if used frequently. Eyelash preparations are likely to be particularly dangerous

Creams or lotions have been advertised to contain vitamins, and certain cosmetics are supposed to have some hormones in them Claims are made that these preparations invigorate and nourish the skin The cells of the skin are not nourished by these or any other 'skin foods" There is only one way for them to receive nourishment and that is from the nutritive materials in the blood

The study of hygiene should result in making us take a critical attitude toward the many unscientific claims that are made today over the radio, in magazines and newspapers, and in other advertising about the so called wonderful discoveries of science which are able to make the old appear young and the plain beautiful, and which produce their magical results overnight

Some skin disorders Acne is the name of the disorder characterized by pimples and blackheads In most cases it is confined to the adolescent period, and quite generally disappears before or during the early twenties The condition is associated with an excessive oiliness of the skin and is supposed to be caused by a specific type of bacillus The eating of large amounts of foods containing fats and sugars in high concentration, like pastry and candy, is apt to aggravate the trouble A program that promotes the general health should help to cure this condition The diet should include plenty of fruits and vegetables, sweets should be avoided, water should be drunk liberally, and there should be regular exercise in the open air If the condition is at all acute, a doctor should be consulted to prevent it from becoming

chronic Certain methods of treatment with light rays, with hormones, and with autogenous vaccines have been found efficacious.

Boils and carbuncles are the result of infections of hair follicles A carbuncle is really a cluster of boils If pimples are irritated by picking or squeezing, the infection may be spread and boils may result Sometimes skin infections of this type result in blood poisoning The wisest plan in the case of a beginning boil is to let it strictly alone and secure medical attention

Warts and corns are due to an excessive growth of restricted areas of the epidermis Corns appear where there is pressure on the toes, most frequently because of badly shaped shoes Their removal should usually be left to a doctor, although there are certain preparations for their treatment that appear to be safe Corns will reappear as long as the pressure remains

Moles are produced by the overdevelopment of the pigment cells just under the epidermis Such growths, if located in places where they are irritated, may become malignant They should be removed only by a doctor

"*Athlete's foot*" is one of a number of related infections, called *favus* or *ringworm*, which are caused by fungus growths somewhat similar to the molds that grow sometimes on contaminated foods It is usually contracted by walking in bare feet over the wet floors in locker rooms or shower baths of gymnasiums It appears on the skin of the feet and between the toes and is characterized by the forming of little blisters which itch to distraction After they break and dry, a crust forms over them This condition is frequently difficult to cure and, if it appears, a doctor should be consulted

Ringworm may attack any part of the skin or scalp Children may get it from playing with dogs and cats, when it is transmitted from the animal to the child It may be caused by infected barber's equipment In choosing your barber be sure that he and his shop are clean

Scabies, or "itch," is caused by itch mites which burrow into the skin, especially between the fingers and toes, in the arm

pits, and on the abdomen They may spread from these places all over the body They cause an intense itching, and a rash develops because of the irritation from the scratching The female can be seen by the naked eye, is pearly white, and lays her eggs in burrows under the skin The trouble is spread by direct contact with infested persons or with their clothing and bedding The treatment consists of baths with warm water and soap, and applications of sulphur ointment Children who are infested should be excluded from school until they are free of the itch mites, and infested persons in general should not be permitted the use of public recreation and bathing facilities

Pediculosis, or lousiness, is caused by infestation by lice, of which there are three kinds, the head louse, the body louse, and the crab louse The head louse is the most common and is found in the hairs of the head It varies in color with the different races it infests It is very dark in the Negro and Chinese and is a light gray with a black margin in the European The female lays about sixty eggs which mature in a week. The eggs or nits' are fastened to the hairs near the scalp and look like white specks The lice bite the scalp, causing intense itching The bites may produce an infection which causes the formation of crusts and scabs The lice may be destroyed by saturating the hair with kerosene and olive oil, or tincture of larkspur There should be repeated examinations of the scalp until the head is free of the nits The nits may be destroyed by dipping the comb in vinegar

The body louse lives in the clothing and is the chief carrier of typhus fever, either from man to man or from man to rat to man This louse was so prevalent during the World War that the clothing of soldiers and of whole sections of the population was deloused by steam pressure sterilizers The general method of disinfection is by sterilizing the clothing

The crab louse infests the short hairs of the body in the pubic regions, the armpits and sometimes in the eyebrows For disinfection the clothing must be sterilized and mercurial ointment

applied to the affected parts which should be thoroughly washed several times daily with soap and water.

Lice are found where there is neglect of the elementary rules of cleanliness. They are spread by contact. A clean person, who happens to come into close contact with anyone infested with lice, or with clothing and linen harboring them, may catch them himself—but he will not keep them. There should be regular inspection of the heads of school children and of their bodies and clothing also, where lousiness is suspected.

»» X ««

THE CONTROL AND INTEGRATION OF THE BODY

I. THE ENDOCRINES AND THE NERVOUS SYSTEM

The integration of bodily activities. There are two sets of bodily mechanisms which control and integrate the processes that go on within us and in large measure determine the ways in which we react to situations in our environment (1) the glands producing internal secretions, and (2) the nervous system, including the sense organs We have given many illustrations of the relationship of the nervous system to the other systems in our descriptions of body functioning for example, the deterioration of muscular co ordination that frequently accompanies mental deterioration, overfatigue as the result of nervous exhaustion rather than muscular exhaustion, the interference in the digestive process by emotional disturbances, the effects upon the nervous system of dietaries deficient in certain essential nutritive elements, nervous tension as a cause of constipation, the effect of narcotics and stimulants upon the nerves that control the rate of the heartbeat, and the vicious cycle of excessive fatigue, nervous exhaustion, worry, and sleeplessness In fact, emotional disturbances caused by worry, fear, or anger may be great enough to produce nausea, fainting, diarrhea, and more serious effects on body metabolism

Thus far in our study, the mechanisms which make possible this control and integration have not been carefully examined It will now be our purpose to ascertain a little more definitely the structure and functioning of those organs which give these characteristics of unity and continuity to bodily processes and activities

It might be well to note at the beginning of our discussion that there are many aspects regarding the control and integration of human behavior which are not well understood and probably never will be completely comprehended For example, science can tell us very little about the real nature of feelings and emotions and how it comes about that we apparently are able to make choices in our behavior However, we do know that certain bodily structures are necessary in order that a person may experience such emotions as love, hate, anger, fear, worry, and pleasure Although just what takes place in thinking and remembering is not understood, we know that if the processes connected with these experiences are to function on the human level a brain is necessary We do not yet know and probably never will understand all the factors determining our behavior, but there is abundant evidence to indicate that things do not just happen as isolated events Any particular event or act is a link in a chain of other events, some of which happened before the particular act occurred and some of which will happen after it. In other words, human behavior, although more complex and unpredictable than other kinds of events in nature, does not constitute an exception to what has sometimes been called the law of cause and effect"

It is possible by a process of conditioning or training to develop certain typical forms of behavior in an individual, which would not otherwise appear If this were not so, there would be no use in programs of education Children might just as well grow up in the woods, if there were not the possibility of molding their personalities by providing certain types of situations In fact, the whole basis of any philosophy of education is this fundamental assumption that environment influences behavior However, there are in all of us so called innate tendencies to react in certain general ways to typical situations, and although these tendencies may be modified through experience, nevertheless they still remain as part of our very selves These tendencies

are sometimes classified under two heads (1) the self-preservation impulse, and (2) the mating impulse There are certain structures in our bodies, the functioning of which makes possible all the multitude of different activities that some authorities claim have their roots in these tendencies

It is not our purpose here to attempt to describe human behavior in any detail That must be left to the psychologist All that we can do is to observe a little more carefully than we have heretofore the general nature of the mechanisms that in large measure control and integrate human behavior An acquaintance with them is basic to even an elementary understanding of what is meant by personality traits

The hormones, or endocrines, are the "chemical messengers" which, upon gaining access to the blood stream, reach all parts of the body and influence many types of activities The nervous system constitutes the means of putting us into relationship with our environment and is the outstanding mechanism in helping us make adjustments to it Without the ability to sense different aspects of the environment, human life would be below that of a cabbage An understanding of the mechanisms regulating bodily activities, insofar as it is possible to understand them, will help to make human behavior—our own and that of our associates—more intelligible to us It should contribute to efficiency and success in living

The "master gland" We have already referred to some of the particular effects of the various hormones on the functioning of the body in our discussion of the different activities of the body For instance we have mentioned the influence of one of the secretions of the pituitary body on growth, of the thyroid on the rate of the metabolic processes, of the parathyroids on the utilization of calcium in the blood, and of the adrenals in converting the glycogen in the liver into sugar We said that there are sex hormones that affect the reproductive functions It will be recalled that we have also discussed the influences of

hyper- and hypothyroidism on the mentality as well as on the rate of metabolism (See page 124)

Our treatment of the functioning of the endocrine glands would be very incomplete if we did not speak in a little more detail of the activities of the pituitary body, or "master gland" (See page 123) It is about the size of a pea but it exerts profound effects upon many different functions of the body, in addition to controlling the activities of the other endocrine glands It acts as a co ordinator to keep them working harmoniously Its hormones regulate the growth and development of the body, influencing the activities of the sex organs and the functioning of the brain In its anterior lobe it produces (1) a hormone that regulates growth, (2) another that controls the activity of the parathyroid, (3) still another that controls the activity of the parathyroids, (4) one that acts to counterbalance the effect of insulin, (5) one that influences the flow of milk in female animals, (6) another that affects the functioning of the part of the adrenals that is essential to the continuation of life, and (7) at least two that stimulate the reproductive functions and the development of sex

The posterior lobe produces the hormone *pituitrin*, which probably contains several hormones for it influences several different activities It raises the blood pressure, stimulates the contraction of involuntary muscles, and helps to control hemorrhages It is used by physicians for these purposes, and sometimes by obstetricians to hasten labor in the later stages of childbirth

General significance and plan of the nervous system There is no one part of the body, exclusive of all other parts, which determines behavior Behavior is a function of the whole organism However, it is true that there are certain structures that are particularly associated with the development of personality traits and of these the most important is the brain

Since intelligent behavior is dependent upon the ability to size up different situations, and since our knowledge of the

nature of the world, including the people in it, is dependent upon our ability to see, hear, taste, smell, touch, it follows that our sense organs play an important part in helping us to meet situations Not only is human behavior made possible as a result of impulses which travel toward the brain, such as those that occur when sense organs are stimulated, but it is dependent upon the passage of such impulses along nerves that finally reach their destination in muscles or in glands

Automatic and conscious activities Ordinarily we are not aware of some of our bodily activities These are the *automatic* activities, most of which are beyond our conscious control Others are usually performed consciously and are commonly said to be under the control of the will, or *voluntary* Some types of activities are at first automatic and later become conscious, on the other hand, many acts which are voluntary in the beginning tend to drop out of consciousness and become automatic to a greater or less extent Our many acquired skills and techniques, like eating with a spoon or playing the piano, generally belong to this latter type However, many of the voluntary activities that have become largely automatic are brought into consciousness if any stress or obstacle occurs In walking over a rough road, for example, we have to exercise some care which makes us conscious of our walking movements

The rate of breathing, the flow of the digestive juices, the movement of food masses and excretory products through the alimentary tract, the heartbeat, the regulation of the flow of blood to different tissues—all of these activities we have discussed and many others that we have not mentioned—are automatic The movement of the skeletal muscles is generally under conscious control, hence they are called *voluntary muscles* to distinguish them from the type of muscles that are found, for instance, in the walls of the alimentary tract, which are not under conscious control and are called *involuntary*

An illustration of a type of behavior which is first automatic and later becomes conscious is the voiding of urine from the

body The baby urinates whenever the bladder becomes distended to a certain extent, the nervous impulses traveling from it to the spinal cord and then back to the sphincter muscles of the bladder As the baby develops, nervous pathways are established between the bladder and the brain, and the action which was formerly automatic comes under the control of the higher

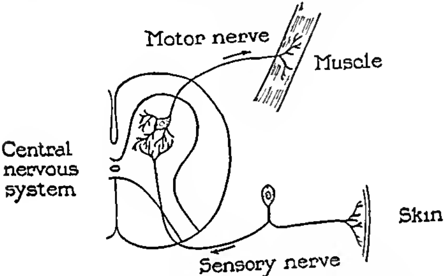


Diagram showing the pathway taken by nervous impulses in a simple reflex act

centers in the nervous system, with the result that urination becomes a voluntary act

From what has just been said it is evident that not all sensory impulses must reach the brain in order to result in some form of activity They may be short circuited and relayed out from the spinal cord They are the simplest type of *reflex acts* Thus, a person may be so sound asleep that when the soles of his feet are tickled he will withdraw them without waking Here, as in the case of the automatic emptying of the bladder, sensory impulses travel along nerve fibers to centers located in the spinal cord, and other impulses are sent out from the cord, with the result that muscles contract and the foot is withdrawn

Reflex acts are of two kinds *unconditioned*, or unlearned, and *conditioned*, or learned responses All animals come into the world with a certain number of unconditioned reflexes This equipment is necessary for their survival Given the same type of stimulus, there will always be the characteristic response, if the organism is normal Thus the new born infant exhibits sucking movements when an object is placed between its lips

The conditioned reflex act is acquired It is built up in an individual as a result of experiences It may become as fixed and automatic as the unconditioned reflex. As we consider the behavior of higher forms of animals compared with lower types, we find the reflex patterns becoming more complex and the responses to given stimuli more uncertain, that is, the number of conditioned reflexes in comparison with unconditioned reflexes grows proportionately greater The greater complexity of the brain permits an increasing variety of responses The behavior of human beings and, to a considerable extent, of other mammals is made up largely of conditioned reflexes On the other hand, insects have very rigid behavior patterns

The experiments with dogs, of a famous Russian scientist, Pavlov, in the field of conditioned reflexes have become very well known He conditioned dogs to various sounds by having a bell ring or a metronome tick just before giving them food The dogs after a time became accustomed to this procedure, and, when hungry, saliva would flow from their mouths merely as a result of hearing the sound which they had come to associate with eating even although no food was given them It is hardly necessary to state that the ringing of a bell will not cause saliva to flow in a dog s mouth when he has not gone through a period of appropriate conditioning

We see examples of similar conditioning in human beings It is a common occurrence to have one's mouth water at the sight of savory food when hungry, and merely thinking about how a lemon tastes will cause the saliva to flow These are examples of

pair passing out between adjacent vertebrae Each of these nerves breaks up into smaller ones which bring practically all parts of the body into relation with the spinal cord The brain and the spinal cord consist in part of thousands of millions of nerve cells They constitute the great central stations, so to speak, into which impulses from various parts of the body are constantly coming and from which other impulses are constantly being sent out

Impulses traveling toward the brain or spinal cord are called *afferent* impulses, and are also spoken of as *sensory* Those which travel outwards are called *efferent*, or *motor*, impulses, because they usually result in some form of muscular or glandular activity

The brain and the spinal cord, taken together, are known as the *central nervous system* The nerve fibers, which connect the central nervous system with sense organs, muscles, and glands, collectively compose the *peripheral nervous system* In reality, these systems are not separate and distinct from one another, but are closely connected and work together as a unit

A third part of the nervous system is especially related to the emotions and is called the *autonomic nervous system* because it plays an important role in regulating the fundamental physiological activities which are automatic, like the circulation of the blood, respiration, and the digestive and excretory processes The autonomic system consists of groups of cell bodies, called *ganglia*, most of which are arranged in a double row rather close to the spinal cord, together with the nerve fibers extending from them to glands, and smooth, or involuntary, muscles These ganglia and the nerve fibers extending from them are connected with the efferent parts of the central and peripheral nervous systems There are also ganglia either within or close to certain of the vital organs in the trunk, that constitute a part of this system

Detailed considerations of the functioning of the autonomic nervous system would be out of place here, but it may be stated that it is essential in helping the body to make adjustments to

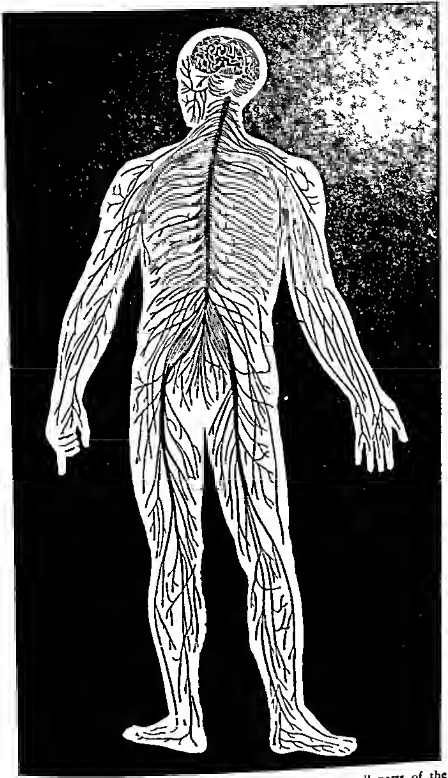
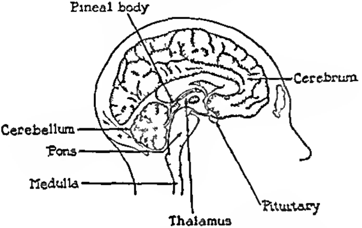


Diagram showing how the nervous system ramifies into all parts of the body (*After* Kimber, Gray, and Stackpole, *Textbook of Anatomy and Physiology*, by courtesy of The Macmillan Company)

changes in the environment A very important part of its functioning is concerned with serving the purpose of self preservation For example, when a person gets angry and perhaps finds that he must protect himself from attack, he needs more energy than usual Under such circumstances the activity of a part of the autonomic nervous system results in stimulating the adrenals to produce an extra amount of adrenalin, which causes the liver



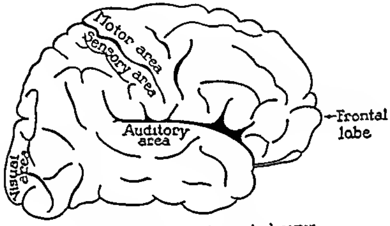
Section of the brain showing some of its major parts.

to liberate more sugar than usual into the blood stream The heart beats more vigorously and digestive processes are retarded All of these responses make it possible for the organism to expend an extra amount of energy, since a greater quantity of blood than usual flows to the muscles and there is more sugar available for oxidation

The brain The brain consists of (1) the two large halves which constitute the *forebrain*, or *cerebrum*, (2) the *hindbrain*, or *cerebellum*, which is below the posterior part of the cerebrum, (3) the *midbrain* which connects the cerebrum with the other parts, and (4) the *medulla* which is the upper part of the spinal cord located within the cranium

The brain and spinal cord are inclosed by the bones of the

skull and spinal column which are connected, in this way making a continuous protection for their delicate structures The *cerebro spinal fluid* surrounds the nervous tissue of the brain and spinal cord and acts as a cushion between them and the membranes beneath their bony covering Sometimes, in the case of certain diseases of the nervous system, such as meningitis and paresis, a *lumbar puncture* is made in the lumbar region of the



Localized centers in the cerebral cortex

spinal cord, or the region near the loins, and some of the fluid is withdrawn for examination This is a valuable help in diagnosis.

The surface of the cerebrum consists of a tissue called *gray matter*, or *cortex*, which is thrown into convolutions that greatly increase its area This gray matter extends about one-quarter of an inch below the surface, where the *white matter* begins. The gray matter contains the cell bodies and the beginnings or endings of nerve fibers, which conduct the motor or sensory impulses respectively There are *centers* or areas in the cortex which make possible the experiencing of certain sensations and the sending out of motor impulses. Such activities as voluntary movements and speech are under the control of motor centers and sensations of various kinds, like those in the skin, and seeing,

reasoning, and imagination On the basis of memory a person may learn from past experiences, and, if they have been rich and diversified, there may be established the possibility of choosing from many different responses the particular one he will make to a given set of stimuli The wise use of this ability to choose between varying types of responses is the fundamental requisite of the exercise of intelligence

The cerebrum shows a much greater development in human beings than in any other animal This is not, entirely, because of the relatively large size of the human cerebrum as compared with that of other animals, but rather to the practically infinite possibilities of making different kinds of connections between the neurons by means of association fibers In spite of this fact habits of thinking and acting may become so fixed that new association paths may be set up only with great difficulty Prejudices and a closed mind involve fixed habits. It is natural that habits should become progressively more set as one grows older, but one should try to avoid forming fixed ways of reacting to situations which, although similar in a general way to those that have been experienced previously, may involve new elements Because of the flexibility of man s brain, it follows that he is the outstanding educable animal Habits may be formed and later broken, new ones being established which often take the place of the old This means that man is better able than any other form of life to make readjustments to continuous changes in his environment.

The cerebellum, like the cerebrum, consists of two hemispheres The function of the cerebellum is apparently that of assisting in the co-ordinating of muscular activities When it is removed from a dog, for instance, there is difficulty in locomotion The animal exhibits sprawling movements when it attempts to walk or run

The medulla controls some of the essential body activities It contains the respiratory center and helps to regulate the heart

beat, circulation, sweating, and swallowing movements These activities are so necessary that they must be carried on automatically

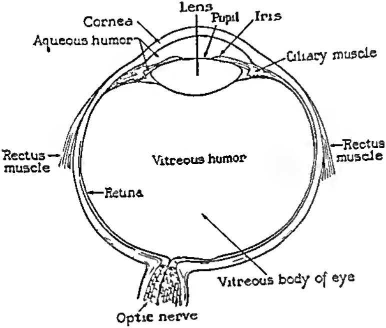
II THE SENSE ORGANS

The sense organs We have already learned that there are certain nerve endings or receptors in the skin, sensitive to stimuli of heat, cold, pressure, and pain When these nerve endings are stimulated, nervous impulses travel toward certain sensory centers in the cerebrum and affect them in such a way as to produce characteristic sensations Nerve endings in the eyes, in the ears, in the nose, and in the tongue make possible the sensations associated with those organs and are all similar in their general method of functioning to the receptors in the skin (See page 265) All of these, in addition to certain other receptors—like those in the muscles and tendons and in the *organs of equilibrium* in the ears, are the sense organs of the body With the exception of the sense of smell, which seems to have deteriorated, the sense organs of man are in general the most wonderfully developed of all creatures Most of what we learn about our environment is made possible by our sense of sight

Structure and functioning of the eye An elementary knowledge of the structure and normal functioning of our eyes will help us to understand how to take care of them The eye is an apparatus which focuses rays of light in such a way as to produce images on a surface It has a tough outer covering, the *sclera*, the front part of which is transparent This transparent surface is called the *cornea* Behind the cornea within the eyeball is a colorless liquid, known as the *aqueous humor*, through which the rays of light must pass before meeting the *lens*, which is a mechanism for focusing them There is also a mechanism that regulates the amount of light which may enter the eye This gives the color to the eye and is called the *iris* In its center is a circular aperture, the *pupil* The pupil may be made larger or smaller, depending upon the action of muscles

in the iris These muscles act automatically, contracting the pupil in bright light and expanding it in dim light

Light waves, passing through the cornea, aqueous humor, and pupil, fall upon the lens and are focused in normal vision upon the sensitive nerve endings that are found in the *retina*, or inner lining of the back half of the eyeball The retina is like the



Longitudinal section of the eye

film or plate in a camera On their way to the retina, light rays, after passing through the lens, traverse a clear, jelly like substance which fills the eyeball behind the lens and which is called the *vitreous humor*

The retina contains a very complicated series of layers of nerve cells, which form the specialized endings of the *optic nerve* It is these cells which are sensitive to light waves and which, upon being stimulated, produce nervous impulses that traverse the optic nerves to the posterior part of the brain where

the *center of sight* is located The different parts of this whole mechanism of vision—the eyes, the optic nerves, and the center in the brain—must work harmoniously in order that vision may be normal

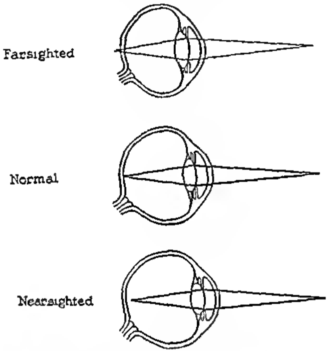


Diagram showing how the shape of the eyeball affects vision

Defects of the eyes The shape of the lens can be changed by means of the contraction or relaxation of certain small muscles called *ciliary muscles* By changing the shape of the lens it is possible to change the location where the rays of light are focused If the lens of the eye is made thicker than ordinary, images are focused in a position in front of the retina Some eyeballs are too long and some too short In such cases vision is blurred unless the focusing mechanism of the eyes compensates for the abnormal condition, or unless properly fitting glasses are used Shortsightedness, or *myopia*, is a condition in which images

are focused in front of the retina. In farsightedness, or *hyperopia*, they are focused behind the retina *Astigmatism* is a condition of faulty vision due to irregular curvature of the cornea or lens or the back part of the eyeball As a result of this, parts of the images are focused upon the retina while other parts are focused either in front or in back of it Those focused on the retina are clear while the rest are blurred

There is reason to believe that in the United States about one quarter of the adult population which is at present without glasses, need them, while another quarter wear them The eye examinations made at colleges every year disclose the fact that large numbers of students have been seriously handicapped for some time before their entrance because they have needed glasses The human eye is a remarkable mechanism which is able to adjust itself to a considerable extent to the demands made upon it, even when possessing much less than normal vision This is the reason why many persons who need glasses are not conscious of the fact Results of eyestrain, however, may cause headaches, pains in the region of the eyes, backaches, constipation, or indigestion Not all of these symptoms are apt to appear in any one person who needs glasses and does not have them, but one or more of them are frequently associated with eyestrain

Care of the eyes From the above description of the structure and functioning of the eyes we may better understand some suggestions regarding their care The eyes are markedly affected by one's general health For example, if one is overtired, the eyes are more easily strained and are usually lacking in luster Nothing can take the place of good health and adequate rest in giving the eyes an attractive appearance

Rubbing the eye in an effort to get rid of a foreign particle is very apt to result in imbedding the particle more firmly in the tissue If it is on the lower lid or the lower part of the eyeball, it may usually be removed easily A clean handkerchief or a bit of sterile cotton wound around the end of a match may be used for the purpose If it is upon the surface of the upper

lid or the upper part of the eyeball, it is usually necessary to turn back the upper lid in order to get at it This may be accomplished by taking hold of the eyelashes and at the same time pushing downward, upon the upper part of the lid, with something round like a pencil Often merely flooding the eyes with a boric acid solution will result in washing out the offending particle

It is unwise to read for a considerable period where there is either too much or too little light Instruments known as *light-meters*, which measure the intensity of light at any given place, are now on the market Their operation depends primarily upon the use of a photoelectric cell which operates a pointer on a dial The degree of intensity of the light is shown by the position of this pointer, and since the amount of light desirable for different kinds of work has been standardized it is easy to determine by this means whether the proper amount is being obtained In reading at night it is advisable to have the whole room fairly well lighted instead of just having the light thrown upon the object one is looking at If the rest of the room is dark, the eyes, which should be rested by looking away from time to time, have to make adjustments which result in strain The size of the pupil changes rather rapidly but not rapidly enough for protection against the sudden glare which results from quickly shifting one s glance from darkness into bright light.

Reading in bed may be harmful unless one has adequate light and is propped up so that the printed page is about on a level with the eyes One should nor read when directly facing the source of light or when the direct rays of sunlight fall upon the printed page It is unwise to attempt to read for a protracted length of time in a moving car or train, because the vibrations result in making it necessary for the focusing apparatus of the eyes constantly to make readjustments The excessive use of tobacco is harmful to the eyes of most people and certain drugs may be injurious

It is unwise to patronize places where free examinations of eyes are advertised In mosr instances such establishments are

interested primarily in selling glasses and not in correcting eye defects There is also a great difference in the quality of the lenses used in glasses Cheap lenses may be inaccurately ground and increase, rather than relieve, eyestrain

Oculists, optometrists, and opticians Oculists, or ophthalmologists, optometrists and opticians all do specific types of work related to the eyes Their training is different and their qualifications should not be, but frequently are, confused The *oculist*, or *ophthalmologist*, is a medical college graduate who has specialized in the study of the eyes As a practicing physician, he is permitted by law to put a drug, such as atropine, in them This is frequently necessary in order to diagnose their condition The effect of this drug is to paralyze the ciliary muscles temporarily, with the result that the eyes may be examined while they are in a relaxed condition, when they lose their power of accommodation, or the ability to focus the rays of light on the retina

It is unlawful for an optometrist or an optician to use drugs An *optometrist* has had special training in making certain measurements of the eyes In many cases he is competent to prescribe glasses but he lacks the oculist's thorough background of medical training The *optician* has been trained to grind lenses and his work is to fill prescriptions made out by an oculist or an optometrist

The superficial testing of the eyes by means of a chart which can be used by anyone who has had a little training is helpful in that it indicates in most cases whether a further examination is necessary However, this type of examination does not disclose certain rather common types of defective vision, especially astigmatism These preliminary tests consist of reading rows of letters from a chart, first with one eye and then with the other, when the chart is placed in a good light at a distance of about twenty feet from the observer The chart contains rows of letters, diminishing in size from the top rows to the bottom. The use of the chart helps to ascertain a number of things, such as

whether the eyes are approximately alike, whether they are nearsighted or farsighted, and if so, to what extent This kind of examination should not be considered final When its results indicate that glasses are either probably or definitely needed, or, if worn, that they may need to be corrected, the next step is to have a more thorough examination by an oculist

In recent years oculists have discovered that some people use only one eye This is because the unused eye is abnormal and hence is used only with great strain This condition is likely to be accompanied by squinting and cross-eyedness If this abnormality is recognized promptly and proper glasses obtained, normal use of the affected eye may follow

Disorders of the eyes *Cataract* is one of the most common disorders of the eyes It is due to the clouding of the lens or the capsule enclosing the lens, which results in shutting out the light to a greater or less extent, that is, it produces varying degrees of blindness As the cataract grows, vision becomes poorer until total blindness may result The condition usually affects both eyes and is most common in old people, although young people and even babies sometimes have it In most instances its cause or causes are not definitely known, although in some cases it appears to be owing to injury or disease Fortunately, it is a condition in which a high percentage of cures follows an operation which involves removing the affected lens If the operation is successful, glasses with an artificial lens restore almost normal vision

Conjunctivitis Conjunctivitis is an infectious disease caused by the gonococcus or one of the group of pus forming microorganisms It is characterized by acute inflammation of the *conjunctiva*, or the mucous lining of the eyelid and front of the eyeball, accompanied by a discharge of pus and mucus It is contracted by contact with an infected person or with articles soiled by infected discharges Sources of infection may be a common towel or washcloth The eyes may also be infected by unwashed fingers which have handled infected articles

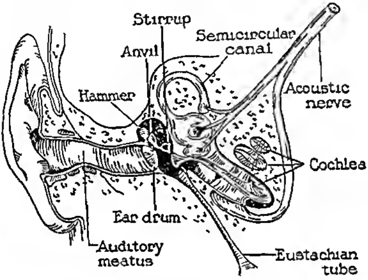
An inflammation of the conjunctiva, called *ophthalmia neonatorum*, occurs in newborn babies. In a large majority of the cases the causative agent was the gonococcus transmitted from mother to child during birth. This disease has been the cause of many cases of blindness. Fortunately it is now uncommon because the laws of most states require the use of a solution of silver nitrate, which destroys the germs, in the eyes of all babies at birth.

Trachoma. Trachoma is another highly infectious disease that is also characterized by inflammation of the conjunctiva, chronic in this case. Its causative agent has not been discovered. It is transmitted by direct contact with an infected person or with articles soiled by infective discharges. Since children are usually more susceptible than adults, any suspected child should be excluded from school and from all association with other children until he has had treatment and has been taught how to keep from infecting others. The disease is of rather frequent occurrence among immigrants from Southeastern Europe and among some Indian tribes and underprivileged groups in certain sections of the United States. Immigrants are refused admittance to the United States, if found to have trachoma.

The structure and functioning of the ear. Sound travels in waves that are produced by the vibrations of the object producing the sound. The mechanism for hearing has been so constructed that the sound waves set up stimuli in the *auditory nerve*, or the nerve that conveys impulses to the auditory center in the brain, which results in the sensation of hearing.

The ear consists of three parts: outer, middle and inner. The *outer ear* consists of the structures that can be seen and the *auditory meatus*, or opening which leads into the head. The outer ear ends with the *tympanum*, or ear drum, upon which sound waves impinge and which cause it to vibrate. Tiny glands that secrete "wax," or *cerumen*, empty into the meatus. The cerumen helps to prevent the entrance of dust and other substances

The *middle ear* consists of a cavity in the temporal bone directly behind the tympanum This part of the ear becomes infected in cases of *otitis media* (See page 163) The three smallest bones in the body, commonly called the hammer, anvil, and stirrup, are located in this cavity. They are so held together by ligaments that when the hammer, which is loosely fastened to the



Diagrammatic section of the ear

tympanum, is set vibrating by it, the other two bones vibrate in harmony A portion of the stirrup fits into an opening which leads into the inner ear

The *inner ear* consists of what is called the *cochlea*, which is in reality a winding cavity, shaped somewhat like a staircase with one and a half turns It contains a fluid which vibrates as a result of the movement of the stirrup and this vibration stimulates the receptors of the auditory nerve As a result of this stimulation impulses are set up in the auditory nerve which travel along it to the center of hearing in the brain The impingement of sound waves on this delicate apparatus enables us to experience the sen-

sation we call hearing Other structures are present in the inner ear which make possible the sensation of equilibrium These structures, three in number, are known as the *semi circular canals* They are filled with a fluid and contain receptors sensitive to the position of the head They convey impulses to the brain, that contribute in a very important way to making it possible for us to maintain our balance in walking, standing, or sitting It is believed that the sensations associated with seasickness result from the excessive stimuli imparted to the nerve endings in these canals

From this description of the mechanism for hearing it is evident that any one of several conditions may result in its impairment. If the ear-drum is seriously injured or if the little bones in the middle ear do not function effectively in transmitting vibrations from the tympanum, the ability to hear is decreased An injury to the auditory nerve or the auditory center in the brain will also result in a greater or less degree of deafness It is estimated that about ten million people in the United States suffer seriously from impaired hearing

The most common causes of difficulty in hearing are the result of a chronic inflammation of the mucous membranes of the middle ear This condition may be intensified in a variety of ways, as, for example, from neglected colds, from blowing the nose too vigorously, and from diving or swimming under water

In all of these cases bacteria find their way to the middle ear through the Eustachian tube and set up an inflammatory condition, which may seriously interfere with hearing if allowed to become chronic Anyone suffering from deafness, even though the handicap may not be very great, should consult a specialist in the diagnosis and treatment of the ear Deafness is apt to be progressive If the condition is discovered early and proper treatment is given, the trouble may be either corrected or at least held in check

Taste and smell The taste receptors are found in groups of sensory cells in the tongue, that we call *taste buds* They are imbedded in certain papillae on the surface of the tongue and when

stimulated produce sensory impulses The taste buds respond to chemical stimulation Substances must be in solution to be tasted, dry materials have no taste until they have been moistened by the saliva of the mouth There is a division of labor among the taste buds just as in the receptors of the skin They are not all excited by the same kinds of foods, but some respond to those that taste sweet, others to sour substances, others to salty and still others to bitter materials

The sensory cells, upon the stimulation of which the sense of *smell* depends, are located in the upper parts of the nasal passages They are found in two areas, each about the size of a five cent piece and are connected with the center of smell in the brain by the *olfactory nerves* Like the receptors of taste they respond only to chemical stimulation, but in the form of gases instead of solutions They are sensitive to very small amounts of odoriferous substances

We often think that we are tasting food when we are really smelling it While food is being chewed the odor arises into the nostrils and stimulates the olfactory end-organs Savory food increases the appetite and usually tastes better When the nostrils are partially blocked by a cold, many foods are tasteless.

III. DISORDERS OF THE NERVOUS SYSTEM

Intelligence and feeble-mindedness Intelligence may be defined as the ability to learn from experience It exists in varying degrees among the higher forms of animals and is primarily a function of the cerebrum As a human being passes through the periods of infancy, childhood, and adolescence there is normally an increase in his ability to make successful adjustments or in the development of his intelligence In the case of some individuals, however, this development is arrested at certain points definitely below what may be considered normal, and such persons constitute the group called feeble-minded

The question may well be raised as to what is meant by the

term normal as applied to intelligence, or for that matter, to any other functioning of the body The term has no absolutely definite meaning It is impossible to draw a sharp line between high grade feeble-minded persons and low grade normal minded persons The two groups merge into each other in so called border-line cases However, a person is usually considered normal-minded who does not fall below a certain level in ability to pass intelligence tests that are appropriate to his age group

According to reliable estimates there are approximately three million feeble-minded persons in our country These people vary greatly among themselves, not all of them by any means being of a type which should be institutionalized They are ordinarily divided into three classes *idiots, imbeciles,* and *morons* The idiots do not possess intelligence higher than that of a normal three year-old child The imbeciles range in their intellectual level between that of the three-year-old and that of the seven-year old child The members of both of these classes need institutional care

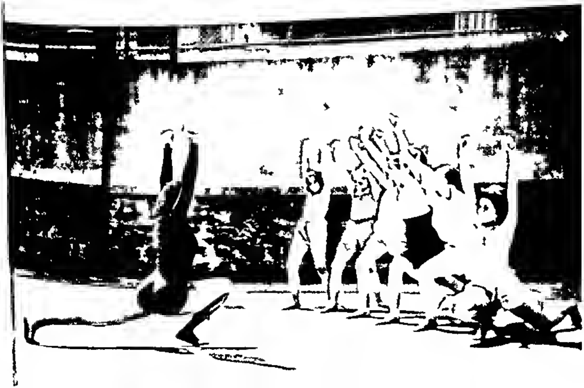
The intellectual development of morons ranges between the seven- and twelve-year-old levels Many of this group are able to be self supporting and many others need only a little assistance On the other hand, not a few morons have an unfortunate combination of behavior traits which make them, if not anti-social, at least unable to earn their own living From the time they start school life they are doomed to failure in competition with more able associates Repeated failures may breed in them hate, envy, suspicion, distrust of themselves—in fact, the whole category of undesirable traits which lead to antisocial behavior Therefore, children of low-grade mentality should not be forced to compete with normal minded children If high grade morons are given a special type of education which is suited to their particular needs and abilities, some of them may become fairly good citizens and the likelihood of their entering the antisocial group, which needs either temporary or permanent custodial care, becomes greatly reduced

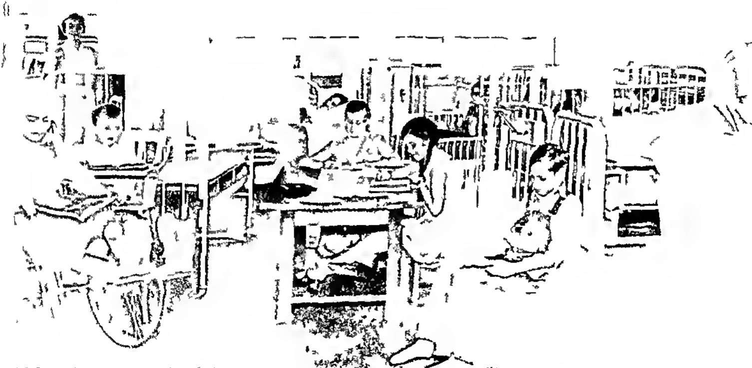
The causes of feeble mindedness Most feeble minded individuals are born with defective nervous systems, although not a few fail to grow up mentally because of some accident or disease which affects their brains during infancy or childhood Although authorities disagree about the importance of heredity in producing feeble mindedness, many of them interpret the data as indicating that at least 50 to 75 per cent of feeble mindedness is of the hereditary type Cretinism, to which we have previously referred, is one type of feeble-mindedness which may be inherited (See page 125) In addition to the hereditary type of feeble mindedness and the cases which develop after birth, there are also those acquired congenitally, that is, the condition was caused by some injury or disease either before or at the time of birth Some of the children of syphilitic parents, for example, are of this type

Some diseases of the nervous system The nervous system, like other groups of organs, is subject to attack by certain microorganisms Paresis, rabies, tetanus, encephalitis, poliomyelitis, and meningitis are especially significant because of their effects upon the nervous system Also, diseases resulting from a more or less marked deficiency in foods containing vitamins B and G, involve derangements of the nervous system (See page 180)

Paresis, sometimes called softening of the brain, is produced by the syphilitic organism, the *treponema pallidum* Not everyone who develops syphilis becomes paretic, it follows only when the organisms attack the brain However, about 10 per cent of the patients in state hospitals for the insane are there because of this disease Until recently paresis has been considered incurable, but now it is known that in many cases, at least, the disease may be checked When its victims are subjected to a high fever for several hours a condition is created in the body that is unfavorable to the continued existence of the treponemata and they may be killed (See page 81) Paresis is a possible end result of syphilis which may have been contracted ten, twenty, or more years before the time it appears Syphilis will be treated in more

Many college men and women are filling summer positions as supervisors of the outdoor activities of younger people (Above *Ewing Galloway* below *Underwood & Underwood*)





In modern hospitals social and intellectual as well as physical rehabilitation is carried on in the work with crippled children

detail in our discussion of the diseases of the reproductive organs

Rabies has its origin in the bite of a mad animal, usually a dog The causative agent is believed to be a filtrable virus which attacks the nervous system, bringing about a progressive paralysis It is practically always fatal in human beings, unless the Pasteur treatment is given If the victim is treated with the appropriate vaccine in the early stages of the disease, cure is certain in almost all cases If an animal suspected of having rabies bites another animal or a person, it should be penned up and kept under observation for seven days to determine if it has the disease If it shows the definite recognizable symptoms of rabies, it should be killed and the brain examined in a laboratory for absolutely certain evidence of the disease In the meantime the only safe course is to start vaccinating the animal or person it has bitten The discovery of the rabies vaccine by Pasteur is described in the discussion of the rise of the science of bacteriology (See page 93)

The common name for *tetanus* is lockjaw It is produced by the tetanus bacilli which usually enter the body through deep wounds A symptom of the disease is markedly painful muscular spasms, some muscles going into a state of prolonged contraction Since in an early stage the muscles of the jaw are affected, it has been commonly called lockjaw The tetanus bacillus is widely distributed in the soil and is especially apt to be in manure It is an anaerobic type of bacterium (See page 252) An antitoxin is available for tetanus and should be used in cases where deep wounds have been made by anything that has been in contact with the soil

Encephalitis lethargica is the name given to a type of sleeping sickness It should not be confused with the African sleeping sickness, which is caused by an animal parasite and spread by the tsetse fly Encephalitis lethargica is believed to be caused by a filtrable virus, of which there appear to be different strains. An epidemic of what is known as the type B variety appeared

in and around St Louis in 1934. The disease is baffling in many of its aspects, including methods of control In some cases it is followed by marked mental deterioration It constitutes one of the rather common causes of ***psychosis***, or derangement of the personality, ordinarily referred to as insanity.

Poliomyelitis, commonly known as infantile paralysis, like encephalitis, is caused by a filtrable virus Headaches, vomiting, moderate fever, pain, and stiffness of the limbs are among the earlier symptoms of the disease Paralysis is a later symptom

It is spread by discharges from the nose and throat of an infected person or carrier Children are much more susceptible than adults The virus enters the nose and is carried to the brain by way of the olfactory nerves Certain motor nerve tracts degenerate, with the result that paralysis of the muscles ordinarily innervated by those nerves occurs The serious effects of the disease may often be lessened by special care and treatment both during the course of the disease and during convalescence During the latter period hydrotherapy and electrical treatments have helped many sufferers to obtain a considerable degree of control of muscles which otherwise would have remained useless

Meningitis is an acute infectious disease of bacterial origin, in which there is inflammation of the *meninges*, the covering around the brain and spinal cord It may be produced by the meningococcus, the tubercle bacillus, or the pneumococcus and other types of bacteria Victims of this disease should be isolated for two weeks after the onset of the illness It is spread by discharges from the nose and throat Chilling and overfatigue should be guarded against by persons who are exposed to possible infection

Psychoses Psychoses involve the derangement of the personality The term insanity is legal rather than medical It is commonly applied to individuals whose personality disorders are so great as to constitute a good and sufficient reason for not holding them responsible for their conduct It appears in a number

of different forms and has many possible causes It is not a disease in the ordinary sense of the word, but some forms of psychoses, as we have previously stated, result wholly or in part from certain diseases or infections Psychoses occur in persons of a normal degree of mental ability, and should not be confused with feeble mindedness which, as we have noted, is a term applied to low grade mentalities that never attain normal development.

In the opinion of many authorities, psychoses are not inherited, although it is also generally agreed that certain forms are apt to appear in persons who have inherited faulty nervous systems, or in those who, for some other reason, are unable to withstand any unusual stresses and strains in life In this sense it is quite likely that heredity plays an important role in either preventing certain types of psychoses or in making persons susceptible to them However, there are frequent instances of their developing in some member of a family where there are no previous records of serious mental derangements

Psychoses are commonly classified as either organic or functional Paresis and the mental deterioration which may follow an attack of encephalitis lethargica are among the common examples of the organic types Other organic psychoses may result from the excessive use of alcoholic beverages and certain drugs or may sometimes be produced by brain injuries and tumors.

Senile dementia, an organic psychosis, is characterized by a deterioration of the brain due in part to the effects of old age, although it is hardly necessary to add that most old people are not subject to it It is not caused by any particular microorganism and cannot be cured by any known methods. There are undoubtedly many factors operating to produce it and they vary with different people Some authorities believe that one of the most significant is the effect of long standing foci of infection. Senile dementia is an exaggerated second childhood Its victims can often remember very clearly events which occurred perhaps

fifty or sixty years ago, but they cannot recall what happened in the previous hour

A psychosis is usually not a condition of sudden oncoming Generally there is a rather long period, often extending through several years, during which the symptoms become increasingly grave until finally the point is reached where institutional care becomes desirable or imperative In no type of insanity is this fact better illustrated than in the most common of all types of psychoses, *dementia praecox* In this disorder the personality gradually becomes shut in, the patient finally coming to live in a world of his own imagining in which he is unable to face reality It becomes extremely difficult to arouse him to make even the simple kinds of adjustments to the actual world He eventually reaches a condition in which he sits in a dejected and pitiable attitude Even doing those things which are fundamentally necessary to maintaining life, such as eating, becomes an intolerable burden, the individual finally returning to a condition which is as helpless as that which characterized his existence before birth

Dementia praecox cases are sometimes characterized in the early stages of the disorder by a failure to live up to what is expected of them on the part of their relatives and friends, the early symptoms usually appearing during adolescence If a child continually experiences failures, his morale may be broken down and he may come to assume an attitude of indifference He begins to picture to himself a world in which he can be successful and he spends more and more time in daydreaming There is some evidence to indicate that if early in the disorder his environment is changed in a way to permit him to make successful adjustments to it, he may be able to face the actualities of living and never become a victim of this psychosis Generally speaking, however, by the time the serious nature of his condition is recognized, there is little hope of effecting a cure It is quite likely that as our scientific knowledge in the field of mental disease advances, methods will be found by means of

mental disorders is second to none in the fields of medicine and public health

Psychoneuroses is the name given to a group of nervous disorders that are characterized by abnormal behavior, but which are not of so serious a nature as the psychoses They arise from an inability to make the usual adjustments to the conditions of the environment and may be due to a number of different causes A predisposing cause may be hereditary structural weakness of the nervous system, which cannot stand unusual stresses of, in some cases, even the customary frictions of everyday living However, a person who may have inherited a sound nervous system may be subjected to such a degree of emotional strain, mental and physical overwork, worry, and poor living conditions that he will break down' under them Also, the abuse of a healthy nervous system by unhygienic habits, the chronic use of alcohol and certain drugs,[1] and repeated emotional excitement may lead to definite nervous disorders In addition, psychoneuroses may be produced by injury, shock, sexual disorders, and certain infectious diseases

Neurasthenia, sometimes called "nervous break down" or "nervous prostration,' is a common form of psychoneurosis It is a condition characterized by excessive nervous exhaustion and general fatigue Among its symptoms are worry, depression, and anxiety, a loss of sense of values, excessive irritability over slight annoyances, inability to fix the attention, insomnia, *phobias* or fears, unusual sensitivity to pain, and various other physical symptoms The phobias are common in severer cases and take different forms *agoraphobia,* or fear of open spaces, *claustrophobia,* or fear of closed places, the fear of being left alone, the fear of people, and a host of other fears

We see incipient forms of the disorder in the ' tired business

[1] Alcoholism and many forms of drug addiction are now recognized as an attempt on the part of the individual to escape life s problems and difficulties The drug habit does not produce the primary mental deterioration On the contrary, the mental pattern of the individual results in the acquisition of the drug habit.

man" and the nervous housekeeper Different types of nervous reactions, like muscular twitchings, weeping easily, and jumping at unexpected noises, may be warning signs of its oncoming If the patient is taken in hand in the early stages, very frequently a program of rest, exercise, and hygienic living in general will effect a cure Usually a temporary change of environment proves helpful

Symptoms of neurasthenia may be seen in nervous, emotionally unstable children who are commonly suffering from the double handicap of a poor nervous inheritance and living in a home where one—or both—of the parents is nervous, irritable, and high strung In such cases education of the parents in the development and problems of children is perhaps the first step in the cure of the child If this is not possible, sometimes the only hope for cure is his removal from the home

In many of the larger cities mental hygiene clinics have been established, which advise parents as to the care and treatment of neurotic and 'problem' children The difficulties of neurasthenic adults often have their beginnings in the mental disorders of childhood Every effort should be made to arrest the development of these disorders early Young men and women of college age who show marked emotional disturbances and a considerable degree of lack of adjustment to their surroundings should seek the help of competent advisors

Changing attitude toward individuals suffering from mental disorders The mind may be regarded as the sum of behavior characteristics Before the sciences of physiology and psychology began to examine the functioning of the nervous system and the role it plays in making possible all types of human behavior, the mind was regarded as essentially mysterious and inexplainable Today, largely as a result of the development of knowledge in these fields, we know that people who are markedly out of harmony with their social environments are unadjusted and not wicked We have come to see that they are frequently victims of heredity and environment over which they

have had little or no control. Mental disorders are frequently caused by physical illness, and some cases formerly considered hopeless now make complete recoveries in consequence of an application of knowledge recently acquired through scientific research. We have mentioned the remarkable results which have followed the use of modern methods of combating syphilis and in treating endocrine disorders. In addition, vocational therapy and hydrotherapy have proved efficacious in producing desirable results with certain types of psychoses.

There has recently appeared a new profession, known as *psychiatry*, which is largely concerned with the early treatment of mental disorders. It has been found that in many cases personalities, which otherwise in all probability would have been hopelessly damaged, have been kept normal as a result of re-education and changes brought about in their physical and social environment. This type of work is in its initial stages and it promises much, not only in helping to lengthen human life, but in raising its qualities to a higher level of efficiency and well-being.

»» XI ««

THE CONTINUATION OF LIFE

1 THE SIGNIFICANCE OF SEX IN HUMAN LIFE

The soma and the germ plasm Up to this point we have been studying about the structure, functioning, and care of the human body as related to the life of the individual rather than the existence of the race In this chapter we shall consider the individual as a part of the on going stream of life—as one of a long succession of organisms extending back into the remote past and forward into the indefinite future Viewed in this way the individual life takes on new significance and meaning

The body appears to perish entirely at death but, in reality, it lives on in the next and succeeding generations. There are two types of protoplasm in the human organism (1) the *soma*, the body, and (2) the *germ plasm*, the spermatozoa or ova. The soma, or *somatoplasm*, may properly be thought of as the house in which the germ cells reside The germ cells are comparatively few in number compared with all the other cells of the body, and yet upon them rests the responsibility of continuing the species. The cells making up the somatoplasm are mortal, they die with the body The germ cells are potentially immortal for the descendants of these cells may live on in other individuals after the body in which they were formed has died. Very early in the development of each of us, indeed before birth, the cells were formed from which mature germ cells are later produced.

The fact that every normal individual in the early or middle teens, if not before, possesses the ability to help create new individuals, carries with it the greatest of all human responsibilities. Parenthood and all that it implies is fundamentally dependent upon *sex*, which means that many living things, including

human beings, are of two types—male and female If it were not for this fact, there could be no such experiences as those associated with love, courtship, marriage, and the founding of a home and family

The biological background Sex does not exist in some of the lowest forms of life We could imagine a world which would contain all the myriad forms of life that we see about us in which there would be no such thing as sex In such a world all living things would reproduce *asexually*, that is, without sex, like the lowest forms of plants and animals which merely divide in two or start a new organism as a bud Bacteria and amoebae are, respectively, examples of plants and animals that reproduce by *binary fission*, or division Yeast is a microscopic plant which reproduces by *budding*, and the little animal known as the hydra also reproduces in this manner, that is, by developing protuberances which become new organisms

Reproduction is of the *sexual* type in all the higher forms of life as well as in many of the simpler forms, that is, two reproductive cells, or *gametes*, must unite in order that a new organism may be produced In all except the very lowest forms of animals and plants that reproduce sexually these gametes are different in appearance, the female gamete being relatively large and passive, the male gamete small and active In the higher forms of animal life the different gametes come from separate organisms which we call males and females Most of the flowering plants and many invertebrates, like earthworms, produce the two types of germ cells in the same individual The term *hermaphrodite* is applied to these forms in which there are both male and female reproductive organs This condition probably never occurs in human beings although pseudo hermaphroditism occasionally appears, in which the reproductive organs are abnormally developed and incapable of functioning

The higher forms of plants reproduce sexually Flowers contain one or both kinds of germ cells the pollen grain contains the male element and the pistil of the flower produces ova As

in the case of animals, so with these plants it is necessary for a sperm cell to unite with an ovum in order that a new organism may form This uniting of the nucleus of the sperm with the nucleus of an ovum is called *fertilization*, whether it takes place in plants or animals It is normally followed by the formation of a new living thing, which for a time during its early existence, is called an embryo Just as in the higher forms of animals the embryo grows for a time attached to its mother s body, so in much the same manner seed producing plants nourish the young plants

Fertilization in animals occurs either inside the mother s body or outside of it, depending upon the species In most fishes the eggs are fertilized outside the body of the female The female fish usually lays her eggs in shallow water where the sun can warm them Close to the eggs the male of the same species deposits *milt*, a substance containing a large number of spermatozoa. These swim about in the water and, as a result of what seems to be a chemical attraction, make their way toward the eggs, one spermatozoon uniting with a single ovum, after which the ovum divides and subdivides until under favorable conditions a young fish is formed

In insects, birds, and mammals the eggs are fertilized in the body of the female as a result of a sexual act known as *coitus* in which the spermatozoa are deposited in a tube or receptacle in the female They make their way along this tube to the ova and fertilization occurs Then for a time, which varies in length with the species, the young develop in the mother s body With birds and mammals a considerable amount of parental care of the young is necessary if they are ever to reach maturity This parental care is carried, of course, much further in the human species than in any other

It has not been our purpose in this survey of how living things reproduce to do anything more than indicate some of the similarities of the reproductive processes in most forms of life If people in general knew some of these elementary biological facts, it

would help them to take a more scientific and wholesome attitude toward the manifestations of the sexual phenomena in human beings Reproduction is one of six or seven life processes that characterize both plants and animals, and it is unscientific to treat it as if it were unrelated to other natural phenomena

The ramifications of the sexual life The sex life of human beings may be considered in its wider significance as consisting of all the emotions, attitudes, habits, customs, and ideals which have their origin in the fact that there are two kinds of people in the world—male and female Although sex involves physical differences and has, in fact, its roots in these differences, it does not stop with the physical but ramifies into most spheres of life The many sex social features of human society are among the outstanding characteristics which distinguish it from the group life of other species

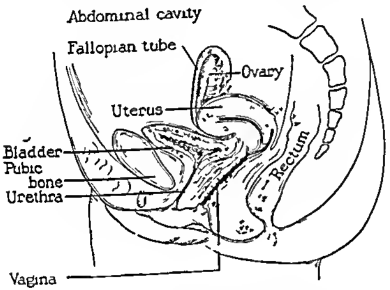
It is true that a few animals, like eagles, mate for life, but most animals mate promiscuously The love of one man and one woman in marriage is an attribute which, in its broader implications, is not duplicated nor even approximated in any other forms of life Although it is usually based to a great extent upon the physical desire for a mate, the experiences which it involves are capable of contributing to the highest elements of man's nature—all of those elements which have made man the peak of evolutionary development in the sphere of behavior Love, loyalty, tolerance, understanding, and sympathy are needed to supplement the physical aspects of marriage if it is to be successful Community of interest and emotional compatibility are also essentials to a happy married life

There are many other areas which are colored by the existence of sex in addition to the interests growing directly out of marriage Some of the rites and ceremonies of religion, as well as many of the formulations of philosophy and ethics, deal with sex social relationships What would literature, painting, sculpture, and music be like if deprived of the emotional appeal which has its origin in sex? Certain aspects of science, sociology, and

psychology are concerned with problems in this field Education must recognize that sex-social situations exist, and a very important part of its program should concern itself with furnishing the training and instruction needed to meet such situations in socially desirable ways

II. THE REPRODUCTIVE ORGANS

The essential parts of the organs of reproduction The male and female reproductive systems have analogous parts They both

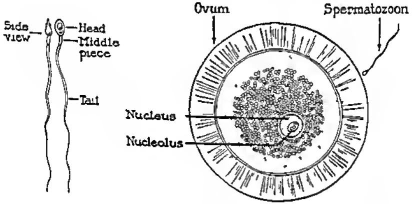


The female pelvis the reproductive organs.

consist essentially of two glandular organs, the *gonads*, and of tubes leading to the exterior of the body. The female gonads are called *ovaries*, and the male, *testes*. The ovaries produce egg cells, or ova, and the testes sperm cells, or spermatozoa.

The female reproductive organs The internal parts of the female organs of reproduction are located in the pelvis. The two ovaries are almond-shaped, and are found one on either side of the perpendicular axis of the body The ovaries produce and

liberate the ova into the funnel-shaped openings of tubes, the *Fallopian tubes*, which connect with the upper part of the *uterus*, a thick, muscular-walled, hollow organ which really constitutes a continuation of the tubes. It is pear-shaped, inverted and held in place by ligaments in the lower middle part of the pelvis. The system of tubes is contioued from the lower part of the uterus through its *cervix*, or neck, and orifice to the outside of the body



Human sperm cells and ovum.

by the *vagina*, or birth canal. Thus there is a continuous passageway from the ends of the Fallopian tubes all the way to the outside of the body.

In most women an ovum matures and leaves one or the other of the ovaries about once in every twenty-eight days. About four hundred may be produced during a woman's life. These two processes are known as *maturation* and *ovulation* respectively. The ovum is a large cell just visible to the naked eye. When it enters the Fallopian tube it is made to move through it toward the uterus by means of cilia which line its inner wall. Its passage through this tube is slow, but it reaches the uterus in the course of a few days, probably three or four. If it is not met by a sperm cell as it moves through the tube, it either disintegrates or is passed out of the body through the vagina. If,

however, it meets with a spermatozoon, *fertilization* occurs and a new life is started. The fertilized egg cell divides into two cells and these into four and so on until there are countless numbers of cells which gradually become differentiated and form the different structures of the body. In an early stage of this development the cellular mass normally moves from the Fallopian tube into the uterus and becomes imbedded in its wall.

Pregnancy and abortion The normal length of prenatal development is about nine months. The period of pregnancy may be terminated prematurely, a seven or eight months' fetus having a chance of survival. *Abortion* is the name given to a premature birth where there is no possibility of survival. This may or may not be induced by artificial means. It has been estimated that there are between 600 000 and 700 000 abortions every year in the United States as compared with approximately 2 000 000 births. It has been further estimated that about 50 per cent of abortions are illegal, a considerable percentage of them being performed upon married women who do not wish to bear children. It is legal for a doctor to abort a fetus when there is real danger to the life of the woman in continuing to carry the child.

It is illegal for a physician or midwife to produce an abortion if there is no danger. However, illegal operations are of frequent occurrence. It involves much greater risk to life than childbirth because of the danger of infection in the uterus of a pregnant woman. Furthermore, although a woman may not lose her life as a result of an abortion, it may be more difficult for her to have a child later. There are at least 50 000 illegitimate births in this country every year, and the number of women dying from all types of abortions is estimated to be in the neighborhood of 15,000. Problems of the type we have here been considering, which grow out of the lack of control or maladjustment in the field of sex social behavior, are among the most difficult that society has to face.

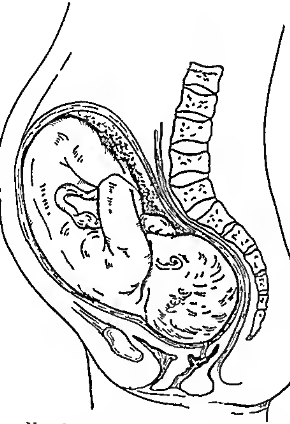
The reproductive period of women, the menstrual cycle The reproductive period of a woman's life begins at *puberty* which

varies in different individuals, but is usually between the ages of twelve and fourteen It ends with the menopause at about the age of forty-five The reproductive system functions between puberty and the menopause Once in every *menstrual cycle*, which is the interim between the maturation of ova, menstruation occurs and there is normally a discharge of mucus and blood from the inner wall of the uterus lasting from two to five days As a result of this process the lining of the uterus is made over at more or less regular intervals. The interims between menstrual periods vary markedly in different women. The average interim is every four weeks, but some women menstruate normally every three weeks and some at intervals of six weeks or even longer There is evidence to indicate that ovulation usually occurs about mid way between the menstrual periods

The phenomenon of menstruation is a normal functioning and most women are not greatly inconvenienced by it. Many older women were taught in their girlhood to regard this period as necessarily a time when they were incapacitated Fortunately, there is a changed attitude today Most women carry on their activities about as usual during this period There are, however, some cases of painful menstruation, or *dysmenorrhea*, that are difficult, if not impossible, to correct entirely Sometimes dysmenorrhea is associated with constipation, poor physical condition, and poor posture Corrective exercises often improve the conditions which are part of the trouble There are sometimes abnormal physical conditions that need medical attention, but, comparatively speaking, such cases are rather uncommon

The male reproductive system The male reproductive system consists of structures which are analogous to those composing the female organs Indeed, in the early development of the embryo its sex cannot be determined because the organs, at that time, have not been differentiated The testes correspond to the ovaries There are two of them and they manufacture the spermatozoa, which are much smaller than the ova A spermatozoon is only about two millionths of an inch in length, and consists of

of the spermatozoa to enter the vagina of the female. When this happens in coitus there may be as many as 200,000,000 of these cells deposited at one time. By means of a whiplike motion of their tails, they are able to propel themselves and some of them



Normal position of the fetus in late pregnancy

may enter the neck of the uterus They make their way through it and enter the Fallopian tubes If one happens to meet an ovum, the nuclei of the two cells unite and prenatal development begins After the period of pregnancy the fetus is normally expelled from the mother's body through the vagina, largely as a result of contractions occurring in the muscular walls of the uterus.

The germ cells contain certain structures, known as *chromosomes*, which, to a large extent, are responsible for the basic characteristics that will appear in the new individual In other words, chromosomes are the carriers of hereditary characteristics This statement is not equivalent to affirming that heredity is the only factor concerned with the determination of human traits In fact, scientific investigations clearly indicate that environmental forces play as important a role as heredity in helping to determine the exact nature of the individual human traits and characteristics that later develop

Heredity sets limits to the development of abilities, both physical and mental, beyond which the individual may not go Such limitations, however, are not nearly so great in normal individuals as was supposed at one time to be the case Certain physical traits, such as the color of the eyes, body build, and the texture of the hair and skin, are inherited, while the development of such characteristics as honesty, criminality, loyalty, alcoholism, etc , are influenced much more by environmental factors than by those of heredity

Internal secretions made by the gonads The testes and ovaries, in addition to manufacturing germ cells, produce hormones which are largely responsible for the development of the so-called secondary sexual characteristics The primary sexual characteristics are those that relate to the reproductive organs themselves The secondary sexual characteristics are the differences in the form of the body, including the development of the breasts in women, the differences in the pitch of the voice or the change of voice in the boy at puberty, the development of the beard, and of hair around the external genital organs, as well as some of the emotional differences which distinguish men, as a group, from women, as a group They normally begin to become prominent at the time when there is a sexual awakening at puberty, and they develop during adolescence

Many experiments have been performed upon animals which throw light upon the functioning of the sexual hormones These

experiments give abundant evidence of their importance It is known that they make possible, in large measure, the development of both the physical and the emotional traits which collectively may be designated maleness and femaleness A bull becomes a steer as a result of ***castration***, or the removal of the testes while still a young animal A stallion becomes a gelding and a rooster becomes a capon as a result of a similar operation The bodies of animals which have been castrated early in life present certain differences in their development and behavior from animals which have not thus been altered

Similar effects are apparent when human males are castrated in infancy or early childhood Such individuals are known as eunuchs They accumulate fat, fail to grow beards and have the voices of children, besides usually being deficient in the traits of aggressiveness and stamina characteristic of the normal male Eunuchs have been commonly used as slaves or servants In some parts of the world, as in China, they are still to be found although the castration of male babies has, generally speaking, been discontinued Women can also be made into what may be described as neuter individuals by a corresponding operation They have a tendency to grow beards and develop low pitched voices like men

Masturbation When the importance of the internal secretions of the gonads in producing certain important behavior traits became rather generally known, it was only natural that many people concluded that these hormones were lost when the seminal fluid was expelled from the body For a time it was stated, even by some physiologists, that this would be especially true if this fluid were lost as a result of masturbation, or artificial manipulation of the external genitals resulting in the male in the loss of the seminal fluid Now, however, it is recognized that there is no evidence to support this idea Hormones can pass only into the blood stream, they do not leave the body Hence, the harm which undoubtedly follows upon frequent masturbation cannot be ascribed to the loss of internal secretions

As a matter of fact, the injury resulting from masturbation has been exaggerated Children have been made to feel that it is wicked, and they have suffered a loss of self respect when the habit has not been quickly broken off This inferiority feeling constitutes most of the harm which the habit may cause It has been widely believed that masturbation might produce delinquency or even insanity This is definitely not true This belief probably originated from the fact that masturbation is often prevalent in institutions for the delinquent and the feeble-minded The truth is that the inmates of such institutions are less likely than others to exercise self control because of their emotional instability, and this lack of control appears in their sexual behavior as well as in other ways

Masturbation is in reality a childish form of behavior which in itself does not usually result in great harm, and which in most cases is outgrown during adolescence It is a habit which is more prevalent among boys than girls although it is not uncommon in the latter A parent who for the first time observes a child masturbating will do well to avoid making too much of the discovery On the other hand, if there is reason to believe that this form of behavior is indulged in frequently, it should not be dismissed as unimportant Perhaps the child s associates are not what they should be Possibly there is something physically wrong If the parent cannot find out the cause of the habit and the problem remains unsolved, he should consult a physician or psychiatrist

III THE VENEREAL DISEASES—SYPHILIS AND GONORRHEA

The venereal or so called social diseases There are three widespread diseases of the reproductive organs They are syphilis, gonorrhea, and chancroid Syphilis and gonorrhea are much more serious and more common than chancroid In fact, chancroid is of such slight significance as compared with the other two that it need not concern us here

Syphilis and gonorrhea are classified as diseases of the reproductive organs because the microorganisms which cause them usually attack the body through the genito-urinary tract. Sexual intercourse is the usual, although not the only way, in which they are contracted. As in the case of typhoid fever and certain other diseases, there are carriers of syphilis and gonorrhea who, although not apparently sick, are in an infectious condition. Investigations indicate that commercialized prostitution may not be responsible for more than about 25 per cent of the cases that occur in the United States. Of course, either syphilis or gonorrhea may be contracted by sexual relations in marriage, where one or the other of the partners has a venereal disease, as well as by illicit relations with individuals other than prostitutes. These diseases are also contracted by using objects that have been contaminated recently by discharges from infected persons.

Other common characteristics of syphilis and gonorrhea are that they are both caused by very sensitive microorganisms which cannot exist very long outside of the human body. They do not remain alive in foodstuffs, as we have found certain disease-producing bacteria frequently do, and this is fortunate, for these diseases would then be even more prevalent than they are. No methods of producing immunity are known, and they are both difficult to treat unless taken in their early stages. Both of them may result in sterility and they are both responsible for causing a considerable amount of blindness.

Syphilis. Syphilis is caused by a microorganism, the treponema pallidum, which is shaped like a thin, elongated corkscrew. (See page 300.) If some of the material from an active syphilitic lesion is examined under the microscope according to a special technique, the germs may be seen. They vibrate and exhibit bending movements. The treponemata may attack any part of the body, and, according to one of the great physicians of our time, Dr. Osler, may cause more deaths than any other microorganism. However, syphilis does not rank high in the records of the causes of death as they are usually compiled. How is it possible then

that syphilis is one of the great single causes of death? The answer is that it is often a complicating factor in many diseases When we were studying about the heart, it was stated that at least one tenth of the deaths from heart disease are owing to syphilis What is true of heart disease is true of many other diseases, especially of the degenerative type, such as apoplexy and disorders of other organs It is the sole cause of paresis, which is responsible for about one-tenth of the admissions to our state hospitals for the insane Syphilis is also the cause of a large percentage of stillbirths, blindness, and feeble-mindedness It is the sole cause of locomotor ataxia in which certain afferent nerves are affected

Authorities affirm that about 10 per cent of adults in the United States either have had or will be attacked by syphilis if conditions are not improved This estimate is not true of all groups of society but rather of society as a whole For example, where a routine test was given to university students to determine how many were syphilitic, only one in five hundred was found to be infected On the other hand, in the poorer classes, especially among Negroes, the ratio is much higher than 10 per cent

Syphilis probably results in disabling one half million of people in the United States yearly, whereas accidents resulting from automobiles and the ravages of tubereulosis combined account for only half this number of disabilities The picture is black and undoubtedly the greatest single reason for the retarding of an effective public health program against syphilis in the United States has been the policy of hushing up all reference to the disease Much could be done to develop a public opinion which would demand a public health progrm in this field, if people were educated to understand the general nature and prevalenee of the disease and the fact that there are effective methods of treatment Those individuals who look upon syphilis as a just punishment for sin and think that therefore nothing should be done about it, need to revise their thinking in the light of modern knowledge

for syphilis is begun before the fifth month of pregnancy in cases of syphilitic women, not only will the women themselves benefit, but there is a much better chance that the babies will live and be normal

The first outward sign of syphilis is a sore, usually upon the genital organs This ordinarily appears within two weeks or a month after exposure The sore may not be very painful, and usually gives little indication of the fact that a serious disease threatens It may last for from two or three weeks to two months During this time a special type of microscopic examination shows the presence of the treponemata, and the disease can be cured in the large majority of cases, perhaps as high as 90 per cent Early in this period the blood test is negative If treatment is not given until the Wassermann is positive, there is not as good a chance of cure, although about two thirds of those who are treated in the early stages recover rapidly Furthermore, although it may not always be possible to effect a cure, a syphilitic person may be made noninfectious and his life may be prolonged by the use of certain drugs

The secondary stage of the disease, which appears after the initial sore has healed, is generally characterized by a rash In some cases other symptoms may be a fever, the loss of hair, and sores in the mouth When this last symptom is present kissing is a means of spreading the disease However, these symptoms are slight in one person out of four and infected persons may go about their daily duties in ignorance of their condition

When this secondary stage of the disease disappears, the treponemata are apt to go into a resting condition in the body—only to wake up, so to speak, some years later and produce any one of a combination of serious results. During this quiescent period there may be no outward symptoms of the disease, the patient thinks he is cured and neglects further treatment The best medical treatment at this time results in less than 50 per cent cures Later when the disease manifests itself in some dangerous form the possibility of cure is still further reduced, and

body, rheumatism of the joints and a form of heart disease being possible sequelae As we have previously stated, the disease is difficult to eradicate, many patients thinking themselves cured only to find, perhaps years later, that the germs were not all destroyed and that the disease has again become active

These are some of the main features of syphilis and gonorrhea People in the United States are not any more susceptible to these diseases than the people of other nationalities, but we are backward in fighting them, owing largely to the sex taboo which exists in our country to a greater extent than in some of the other civilized nations Until syphilis and gonorrhea can be regarded by the great mass of people as a public health problem, deserving of the same kind of treatment as tuberculosis, diphtheria, typhoid fever, and other infectious diseases, it will be impossible to bring them under control and reduce markedly the human suffering and misery that they cause

IV SEX EDUCATION

Meaning, scope, and limitations of sex education Sex education includes any kind of scientific information or experience which helps an individual to make desirable social adjustments, the need for which arises out of the fact that there are two types of people in the world, male and female Regarded from this point of view sex education is not merely the acquiring of information about reproduction and the venereal diseases, like that contained in the preceding pages Indeed a person may be well informed about these subjects and yet may not be really educated in the field of sex social relationships We are not saying that information about sex does not constitute an important aspect of sex education, in fact, it is not possible to think of anyone s being truly educated in this field of human relationships who does not possess this kind of information However, the most important thing is, not merely to possess such knowledge, but rather to see to it that it functions along socially desirable lines Mere knowledge,

in and of itself, is of no value The significant goal of this kind of education is the development of socially desirable habits and attitudes

Children learn more from what they observe and from what they do than from what they are told Too often what they are told about sex is at variance with what they observe taking place around them and what they experience in their own contacts with others Thus they are apt to be led to dualistic thinking about sex, and to secretive habits and conduct which are unwholesome In many instances, by their evasion of the subject, parents unintentionally create the impression in the minds of children that sex is intrinsically base and vicious This not only is harmful to the child but it is not true

Thus far we have been dealing in generalities The practical question is what can be done about it In the first place, unless the parents own adjustments to sex social situations are wholesome, no amount of moralizing upon the subject is helpful The first duty of parents from the viewpoint we are here considering is to create a decent home life for their children Maladjusted young people are more apt to come from homes that are either unhappy or actually disrupted than are socially well adjusted children This applies to sex maladjustment as well as to other forms.

In the second place, the imparting of sex information is generally admitted to be an important responsibility of the home Therefore, if for no other reason, parents should become acquainted with the basic scientific facts of reproduction and sex-social relationships Obviously, in a limited treatment of the kind that is here possible, all that can be done will be briefly to consider the type of information which is apt to be needed at different periods before maturity is reached

Sex instruction appropriate for different ages As a general thing a little child of four or five years of age or even younger is inquisitive about a great variety of things and these include questions about the origin of life If the child has not asked its

parents such questions, most authorities agree that it would be wise for the parent to take the initiative in unobtrusively introducing the subject, if for no other reason than to forestall the haphazard and often undesirable sex information the child will surely come across Indeed, it is not unlikely that if the child, even as young as the age mentioned, has not already asked such questions, it has begun to obtain information in ways that frequently result in the formation of distorted ideas

Most children of the preschool age are satisfied by a little information on the subject They do not want and should not be given detailed information about either the sexual act or the processes of birth During this period the broad foundation of a general biological knowledge regarding the reproductive functioning of plants and animals, as well as of man, can be built. More detailed information may be given later The child can be made to see reproduction as one of the great life activities of plants and animals, as something no more mysterious than the beating of the heart or the movements of breathing

In later childhood the early, elementary nature study should be continued As part of this study the boy or girl should understand the nature of the processes of reproduction The girl should be prepared for adjusting herself to menstruation, the boy to nocturnal emissions, and both boys and girls should understand the significance of the awakening of their sexual natures.

During the adolescent period there should be instruction in the social aspects of sex education, including a consideration of such topics as the following sex social standards, marriage and divorce, prostitution, the venereal diseases, illegitimacy, the facts and principles of heredity, sterilization, birth control, and something about the psychology of sexual behavior There are at least two reasons for not entering upon a discussion of these topics at this point of our study The first of these is that some of them have already been treated, and the second is that, in most of their aspects, they constitute problems in the facts and principles of public rather than individual health Our present purpose is to

obtain a survey of the latter field rather than the former If, however, the reader desires to supplement the text by reading about any of these topics, he will find reference material in the Appendix

When the child begins to go to school and make numerous contacts outside of the home there is need of other agencies cooperating with the home in helping to establish sex socially desirable habits and attitudes Often the incidental teaching is most important, together with the creation of an environment in which older children and adolescents, both boys and girls, may work and play together under proper supervision If parents and others, who share the responsibility of helping to create an environment in which youth may experience desirable growth, are oversolicitous about their welfare, if they are constantly acting as if the young people could not be trusted to do the right thing under most circumstances, then the young people are apt to rebel and assert themselves in ways that are afterwards regretted by all concerned

By way of summary, it may be said that the general purpose of sex social education during the later years of adolescence should be to develop social insight If this is accomplished, young men and young women should be able to make more intelligent adjustments to everyday living and at the same time contribute to the well being of others

»» XII ««

MENTAL HEALTH

I BASIC FACTORS IN THE DEVELOPMENT OF THE PERSONALITY

The meaning of personality *Personality* is sometimes defined as the way we affect other people, and so we describe another person as having a pleasing personality or a displeasing one We mean that his traits or ways of acting are in the one case agreeable to us and in the other case offensive *Character* is sometimes called the true self However, like personality, a person s character can be evaluated only by his behavior We sometimes make a distinction between personality and character by saying, for example, that a certain individual has a strong character, but not a pleasing personality

Other terms closely associated in meaning with personality and character are the *self* and the *mind*, but again the only way we have of judging a person's mind or self is by his behavior Character, personality, mind, and self then are all alike in that behavior is the manifestation of them Since it is the only outward expression of them, we shall not attempt to differentiate between them in this discussion but will use them more or less interchangeably

Meaning and aims of mental hygiene *Mental hygiene* deals with the field of personality development. It may perhaps be defined best in terms of its aims Mental hygienists are concerned with the study both of the factors that contribute to the development of socially desirable traits as well as those that may lead to social maladjustment Their aims are two fold (1) to make possible the attainment of an integrated, successful personality, and (2) to prevent or cure abnormal or socially undesirable behavior

Some characteristics of personality Personality is an expression of the whole organism, not of a part It is intangible It cannot be analyzed or examined with the same degree of scientific accuracy that we can use in studying any one of the different organs of the body

Personality has certain characteristics which are more or less contradictory It has continuity and yet it is constantly changing We do not wake up in the morning to discover that we are markedly different from what we were the day before, and yet no one exhibits exactly the same personality from day to day and from year to year We are constantly being changed by our experiences although such changes are usually very slow

Personality is not completely unified, it is many-sided Each of us has many selves We speak, for example, of our best selves and our worst selves and sometimes we say that we couldn t have been ourselves, or in our "right mind," to have acted as we did In fact, we exhibit a number of different selves every day There is the self that we show to our intimate friends and other selves which appear in our everyday activities The business man may be hard and cold in the office In his home life he may be very tender and considerate of others, and he is in some respects still different in his ways of behaving at the club, on the golf course, and at church A young woman is not the same with the young man to whom she is engaged as she is with her brother or girl friends Varying circumstances call forth varying reactions in each one of us that are at times so different that we appear to be different persons

These descriptions of personality or the self and especially our survey of the functioning of the nervous system indicate that it is not simple but exceedingly complex In fact, it is so complex and human behavior is so unpredictable in so many instances that methods permitting scientific analysis and investigation have been evolved only comparatively recently However, within the last hundred years, and especially within the last few decades, considerable progress has been made in under-

standing it Out of the vast amount of research in physiology and psychology there are gradually emerging facts and principles that every intelligent person should know, which will help him to understand the nature of his own behavior and that of the people around him

Mechanisms of personality development There are four large groups of factors that are concerned with personality development (1) the bodily mechanism which we have been discussing throughout this book, (2) heredity, (3) the environment, physical and social, and (4) human needs, wants, and desires From a study of the nature of these factors and how they act and react upon each other it is possible to obtain a better conception of the meaning of personality and its development

The influences of heredity and environment on the bodily mechanism The personality of any individual is influenced by the nature of the chromosomes in the fertilized ovum from which he developed—in other words, he inherits the mechanisms which make the development of traits or characteristics possible However, personality is not determined entirely by inheritance Environment has at least an equal amount of influence in the nature of its development It is owing to heredity, of course, that a fertilized human egg cell develops into a human being rather than into a horse, cow, or tree, but it could develop into nothing at all if it were not surrounded by an environment that makes its growth possible

Undoubtedly some people inherit the capacity of developing stronger bodies than others It is true also that some of them are born with faulty structures that interfere with the development of a normal personality These may be inherited, or they may be caused by faulty nutrition of or injury to their mothers before their birth, or by injury at birth In this discussion we are considering the development of individuals who are born with normal capacities

The types of physical structures—nervous, glandular, muscular, circulatory systems, for example—any person comes to possess

are in part dependent upon the nature of the germ plasm from which he developed and in part upon his experiences which extend back to the time before his birth The fertilized ovum contains potentialities of structural development that make possible physical and mental growth We are born with capacities for developing emotions and with certain general tendencies to behavior Psychologists no longer believe that human beings come into the world with a large endowment of *instincts,* or fixed innate behavior patterns Behavior patterns are established as a result of the conditions of the environment However, the ability to establish behavior patterns and experience emotions is a function of the organism, and the possibility of their development is basically a matter of inheritance The capacity to love, hate, be angry, or pleased, and to experience feelings of satisfaction or dissatisfaction, is just as much a part of one's equipment in life as are the bodily organs What we really inherit, however, is structures and not personality traits Given a child with normal physical structures at birth, it is reasonable to believe that what he later becomes depends largely upon the influences of his environment. It is now recognized that there are wide limits to the possibilities of most of us when we are born

Factors in the environment Every human being that comes into the world finds himself under the necessity of making adjustments to his environment He has to learn how to act in order to get along with his associates It may be said that personality develops out of interactions which take place between an individual and his environment. He does something to his environment and the environment does something to him In general, we tend to repeat those experiences which give satisfaction and we tend to discontinue the behavior which has painful or unpleasant results It therefore becomes the business of parents, educators, and others interested in young people to help create environments in which socially desirable types of reactions bring about feelings of pleasure or satisfaction, and in which undesirable behavior that results in pain or dissatisfac-

tion is frowned upon No two people have experienced exactly the same kind of interactions between themselves and their environments and no two individuals act exactly the same in spite of the fact that the circumstances surrounding them may in many respects have been similar

The environment includes much more than purely physical surroundings It includes people, laws, customs, ideals, and standards People associate different ideas with such words as home, father, mother, parenthood, brother, sister, and sweetheart because of a difference in background of experience To some people there is no temptation to take things that do not belong to them, whereas others find it difficult to keep their reactions along this line socially desirable Some people are friendly and others are inclined to be suspicious in their behavior In order to understand why people vary so widely in their behavior and in their reactions to similar situations and ideas, it is necessary to examine into their past experiences When this is done their present conduct may be seen to follow naturally upon their previous behavior

The need for a desirable social environment Although certain basic physical aspects of the environment may remain more or less unchanged throughout life, its social features, necessary for normal growth, are quite different as the individual passes through various stages in development This fact is well illustrated in considering what we may call the development of the affections

Many psychologists describe their development in some such manner as the following The first 'love object" of the baby is the mother or the nurse who feeds and takes care of him A little later some particular buddy is the center of affection who is usually of the same sex although someone of the other sex may serve this purpose A little later still the affections and loyalty are largely transferred to a group—a gang or team Still later, usually by the middle of the period of adolescence, the boy or girl normally becomes interested in several members of the

other sex and finally this interest becomes naturally focused upon some one person with resulting courtship and marriage. It naturally follows that the type of interest predominating at any particular period helps to determine the kind of social environment which is desirable and even necessary for proper growth and development of the affections

What is true of the development of the affections is also true of the intellectual and physical development as well Different kinds of environments are needed at different periods of life, if young people are to experience a normal growth It is the primary function of all who share the responsibility of supervising their activities to see to it that appropriate opportunities for development exist Of course, as an individual grows into maturity he becomes in no small measure responsible for helping to create his own environment However, since the habits and trends of thinking which are developed early in life play a most important role in determining the personality development, the responsibility of the home is most significant.

Human needs, wants, and desires as they affect the personality Our basic needs and desires affect the development of the personality They may be analyzed in different ways We shall consider four (1) certain basic physical needs, such as food, clothing, shelter, and freedom from disease, (2) the desire for companionship, (3) the need of sex social experiences, and (4) the desirability of having a worth-while task, in the performance of which the individual experiences satisfaction and some degree of success

The need of food, clothing, and shelter is fundamental If they are not furnished in a fairly satisfactory manner, the results are bad in every way A person who is in a chronic condition of malnourishment has low vitality and does not react to situations normally Even a temporary condition, such as a headache, a toothache, or being tired and hungry, markedly changes one's behavior In this book many illustrations of the ways in which

the bodily conditions affect one's behavior have been given, and we shall not here attempt to enumerate them

The need of companionship in order to develop a healthy personality is also commonly recognized One of the advantages in going away from home to college is that it usually affords an excellent opportunity for meeting many different kinds of people Of course, the type of friends one chooses has a great deal to do with the results that will follow upon the experiences of comradeship

In our everyday relationships with others a sense of humor helps, especially when one is experiencing severe stresses and strains If one can look at himself objectively as he might regard somebody else, he is in a better position to solve his personal problems than if he concentrates entirely upon his own desires and feelings

A third great human want is that of sex social experiences This statement is not intended to mean that the experiencing of sexual relations is a necessity for personality development or even for the maintenance of health Indeed authorities in this field of human behavior are quite united in denying the existence of the so called "sexual necessity" A rather common cause of mental upsets is owing to the consequences which frequently follow a disregard of social standards in this field

Most people need the companionship and friendship of individuals of the opposite sex as well as of their own In the period of later adolescence it is highly important that the personality should be rounded out in such a way as to make it possible for young men and women to be at ease with and react in socially desirable ways to each other Such an aim cannot be realized, if they fail to have opportunities of becoming acquainted with individuals of the other sex The attainment of *hetero sexuality*, or an interest in and a desire for the companionship of members of the other sex, is apt to be rather difficult in adolescence unless boys and girls have had healthful relationships with each other in childhood

about unsuccessful marriages. The number of unsuccessful marriages should not blind us, however, to the fact that the majority of individuals are at least fairly successful in making adjustments in marriage and that marriage affords the richest opportunities for co-operation and mutual good will and understanding.

A fourth need is that of having tasks that are congenial and in which it is possible to attain a fair measure of success. A feeling of inadequacy or inferiority is the cause of many weaknesses in the personality. Nothing is more damaging to character development than experiencing continued failure. A person with such a history may come to regard himself as doomed to be a total failure when as a matter of fact, if he were to change the nature of his work, he might attain a considerable degree of success. A very important field of mental hygiene is concerned with helping young people find congenial occupations, and considerable progress is being made in the formulation of aptitude tests in guiding them in the choice of suitable occupations. This kind of work has progressed far enough to furnish some basis for believing that, as a result of the development and wider use of such tests and of vocational guidance clinics, more and more people will find themselves engaged in congenial work with the resultant probability of attaining success in it.

Summary of factors in the development of personality. By way of summarizing the factors that determine personality development, it may be said that every infant comes into the world as a bodily mechanism which has certain capacities for physical and mental growth, depending upon the type of nervous system, glands, muscles, circulatory system, etc., that he possesses. If he is abnormal or weak in any of these respects, his capacity for development may be restricted proportionately. The direction of his personality growth will depend largely upon the nature of his environment. No one develops all his capacities to the fullest extent. The environment inevitably exerts a selective effect upon the growth of interests and abilities. In other words, no one person can be a doctor, lawyer, merchant, plumber, archi-

tect, minister, musician, painter, sculptor, educator, and scientist There is always the necessity of making a choice, or perhaps it may better be said that the environment makes this choice for us

II THE ROLE OF INTELLIGENCE

Temperament, habits, attitudes, and capacities, as elements of the personality Personality is sometimes defined as the organization of the temperament, habits, attitudes, and capacities *Temperament* is the set or general attitude toward life Common expressions that are used to designate different kinds of temperaments are sanguine, or optimistic and vivacious, phlegmatic, or cold, calm and self possessed, choleric, or excitable and hot-tempered, melancholic, or depressed and sad Before the study of the body was organized in the modern sciences of physiology and psychology, these different types of temperaments were associated with what were called humors, or bodily fluids, and it was believed that a person's disposition or temperament was determined by the particular kind of bodily fluid which predominated over the others The sanguine person was full-blooded, phlegm predominated in the phlegmatic individual, yellow bile was associated with the choleric person, and black bile with the melancholic

The relationship between these so called four humors and temperament colored the thinking of the medical profession for centuries and existed even in the days of ancient Greece At first it marked an advance in the study of the human body as an effort to relate temperament to physiological functioning instead of ascribing it to supernatural forces Indeed, there is a germ of truth in these ideas although they themselves now appear ridiculous The florid full blooded individual is usually optimistic and energetic, and heart disease and disorders of the liver have a depressing effect upon the unfortunate sufferer s attitude toward life One s physical condition goes a long way toward determining his temperament It is difficult to be cheerful

when suffering from a jumping toothache, a headache, or an attack of indigestion Most people have a tendency to be either optimistic or pessimistic, and it is this general set of their behavior that constitutes their temperaments

Habits, or conditioned reflex acts, are generally defined as specific ways of doing things and are more or less fixed forms of behavior. (See page 280) There are certain types of behavior that it is necessary to establish as habits, if we are to have time for anything beyond the bare routine of living Those things we have to do day after day, such as washing and dressing, using eating utensils, writing, etc , can only be done effectively when they become largely automatic. Mental reactions to routine situations may become just as habitual as physical reactions Conditioned reflexes develop in every sphere of behavior Imagine what life would be like if one had the same difficulty with handling a spoon, with the multiplication table, with driving an automobile that he had the first time he tried it Habits give us time for other things Because routine acts can be performed without using the higher centers in the brain, we can become efficient in other forms of behavior than those that are directly concerned with what we have to do every day and sometimes many times a day.

Just because the same act often repeated becomes habitual, a very essential part of character development consists in making choices of the forms of behavior that will lead to good habits We may literally be made or betrayed by our conditioned reflexes Habits which are ordinarily good may at times be undesirable, if the customary reactions to given stimuli are not revised in the light of exceptional or unusual situations A man who is used to eating his dinner at a regular hour may be made miserable, and may make those around him so, if it is not ready just at its accustomed time, or a neat housekeeper may become nervous and emotionally upset over the mud dragged in on the shoes of her boy Meals at regular hours and a tidy clean house are to be desired, but adaptability to an un-

usual situation which cannot be changed is even more desirable

Habits should be subordinated to intelligence and should be evaluated in the light of their consequences. Consider the act of a prison guard that led to the loss of a number of lives in a fire. The habit of obedience to orders in a prison is usually highly desirable and necessary, but inflexible unreasoning obedience may be followed by undesirable consequences. In this case the guard refused to open the cells of the men when the fire alarm was given until it was too late to save their lives, because it was contrary to rules to open them at that hour. Contrast this action of the prison guard with that of the priest in the novel, *Les Miserables*. When the police officer attempted to arrest the poor escaped convict, Jean Valjean, for having stolen the priest's one cherished possession, his silver candlesticks, he broke the habit of truth-telling of his whole life and said that he had given them to him. By this act he made possible the regeneration of a human life. It has been said that there are no good habits except the habit of not forming habits, and it must be admitted that there is some truth in the statement, if a habit involves an inflexible type of behavior.

Attitudes are more flexible and generalized ways of behaving than habits. We speak of a friendly or a suspicious attitude, a domineering or a subservient attitude, an attitude of good will or one of hostility. Attitudes, like habits, develop out of one's experiences. As an illustration of the role of the social environment in the development of attitudes, let us consider two incidents which occurred in the lives of two children. The circumstances surrounding these two incidents had in them certain common characteristics and yet since they were handled differently by the mothers they had markedly different effects upon the children. The youngsters were about the same age and they had both taken something that did not belong to them. In one case the mother realized that it takes time to develop an adult's point of view regarding ideas of right and wrong in relation to the possession of property. The other mother acted

as if she thought her child was as responsible as a mature person

A little girl had gone with her mother into a beautiful store in a large city Upon coming out the mother was surprised to have her daughter show her two little silver salt cellars and make the remark "What did you get, Mommy? See what I got!" The child had a doll-house at home and was thinking how pretty the salt cellars would look in it This mother was wise She knew there was no idea of stealing in the child's mind and so she did not show particular concern about the act She informed her that people do not take things in that manner out of stores She called the clerk and paid for the salt cellars quietly and in a very matter-of-fact way. Her child had a valuable lesson without making her feel that she had committed a crime Some parents would have made a scene either in the store or upon arriving at home, which would have resulted in harm to the emotional life of the child There was an interaction between the child and her environment of such a type as to result in benefit to her

Contrast this method of handling a difficult situation with the following incident A boy of about the same age as the little girl took five cents off a dresser in his mother's room to buy some cookies When his mother discovered his act she lectured him severely upon the "crime" he had committed She visualized his growing up to be a thief She told her husband about it and he took a very serious attitude toward the affair For a long time the child avoided policemen thinking that he might be arrested and sent to prison for having taken the money His mother had only the best interest of her child in mind, but the method employed in attempting to correct the unsocial behavior left a sense of injustice and an emotional hurt that lasted for years

Psychologists state that the often forgotten experiences of early life are important in helping to determine one's behavior in later life The incident for the little girl had a constructive value The boy for the time being at least felt that he had been very sinful and was different from other boys Practically every-

the formation of habits and attitudes However, the mere possession of a high ideal and its expression in behavior will not necessarily insure either a successful life or a happy one If the attainment of an ideal becomes an end in itself rather than a means to a richer and fuller life, it ceases to possess any moral value and may become an evil All choices in which the ideal in question enters as a factor are disposed of automatically in view of the dictates of the ideal The examples which we have mentioned of the prison official and the priest show in one case how a fixed ideal may result in inhuman behavior In the other case we saw how the application of a flexible ideal becomes a matter of considering relative values and permits of occasionally disregarding it when it comes into conflict with some still higher ideal

The prison official did not recognize the fact that his habit of obedience was an ideal that might sometimes be set aside, he made it an end in itself On the other hand, the priest was conscious of the possibility of rescuing a human life, if he made his habit of honesty subservient to the ideal of helping a fellow-man and, through him, society in general In other words, the application of any ideal should be relative to time, place, and circumstance

Ideals have a definite effect upon mental health They must be based on straight thinking, an appreciation of human values, and intellectual honesty We are all of us from time to time faced with dilemmas which involve the happiness and well being of others Under such circumstances we should consider all sides of the question and take into account the probable effects of different kinds of conduct upon the lives of others as well as one's self If life did not frequently involve a conflict of ideals, it would be simpler but not nearly so interesting and stimulating

To have one's ideals shaken or actually broken may have a salutary effect We all have this type of experience It is an important part of growing up When it happens it necessitates the reorganization of our thinking and the making of new adjust-

ments Some people are unable to do this They refuse to face reality and may, as we say, "go to pieces" They never grow up, and in some respects this is doubtless true of all of us

Levels of thinking John Dewey describes four levels of thinking, an understanding of which throws light upon the development of personality According to Dewey these levels of thinking may be outlined as (1) daydreaming, (2) "spinning a yarn", (3) rationalizing, and (4) reflective thinking, or the scientific method All of these levels of thinking have a legitimate place in one's life although each of them may be abused

In *daydreaming* the thoughts come and go without any logical sequence It is the kind of thinking one experiences when dropping off to sleep There seems to be no rhyme or reason to it Daydreaming has its place for relaxation, but when it occupies time which should be used in attacking the problems of life it becomes an evil Dementia praecox patients are characterized by an abnormal amount of daydreaming (See page 304)

"*Spinning a yarn*" is on a little higher level of thinking It may be described as the kind of thinking in evidence among youngsters when one will start a story and the others make up parts of it in turn There may be some element of logical thinking—at least events are thought of as happening in a connected series This type of thinking may also have some value as a means of relaxation

Rationalization is that type of thinking in which one starts out with some sort of belief or assumption and attempts to justify it by the collection of data that will support it, at the same time refusing to consider any facts that might refute it Rationalization easily becomes an impediment to making desirable adjustments to changing situations Those who rationalize a great deal become narrow minded bigots who see the procession go by them and are unable to make the necessary adaptations to keep up with it It is a tendency against which everyone needs to guard Those things about which many people have strong feelings, such as religion, politics, sex social relationships,

many other experiences, and from data obtained from correspondence with scientists at home and abroad

Steps in the use of the scientific method, or reflective thinking There are certain steps in the use of the scientific method which are so significant as to justify further consideration These steps are (1) the recognition of a problem, (2) scrutiny of the problem from different angles, (3) setting up hypotheses as to ways in which it may be solved, (4) testing these hypotheses, and (5) arriving at some tentative inference or conclusion Let us give a few illustrations to show what these statements mean

Problems vary from very simple ones which can be solved in almost a flash by reflective thinking, to those which have baffled the most brilliant minds through centuries Every intelligent person makes frequent use of the scientific method without realizing it Whenever there is a question to be solved, there is opportunity for using this type of thinking Where did I put that suit of clothes? Quickly one goes over the possibilities Perhaps it is at the cleaner's! Maybe I put it away in another closet! One by one the possibilities are reviewed until, either as a result of searching or by a process of memory, the problem is solved

There is the problem of choosing a vocation One may merely drift into a job There has been no scrutiny of the situation, no hypotheses set up and checked off against certain facts, such as expense and time for preparation, latent ability, and one's likes and interests Many people never fully wake up to the fact that, since life presents situations in which it is necessary to make choices, they must face problems which demand clear thinking They go ahead and do those things that appeal to them at the moment

The ability to face problems, examine them, and try to visualize the probable results of different lines of conduct is a characteristic of an intelligent person It has distinct moral value, provided one makes socially desirable choices after the reflective thinking has occurred In fact, morality consists in making wise

choices That individual who is a good citizen merely because his surroundings prevent him from being a bad citizen is not deserving of any praise The difficulty, of course, resides in the fact that we are often too lazy to carry on reflective thinking, we tend to be ruled by our emotions more than by our intellects

However, like every other good thing, the use of the scientific method may be carried to such an extreme that it becomes an evil No one is able to obtain all the data that might conceivably throw light upon human problems If a person waits until all the possible data have been collected before acting, he will frequently find himself "on the fence" Action may be so delayed as to be ineffective It is necessary at times to take the word of someone else, if our lives are to amount to anything The intelligent person always considers the probable validity of his sources of information, and gives preference in his thinking to the opinions and judgments of recognized experts in various fields. It is well to remember that merely because a person has gained eminence in one field of human interest or activity, he is not for that reason justified in speaking with authority about problems in other fields which have little connection with the one in which he has specialized

Some problems require a long period of time for their solution. The problems of the movement of the blood and the causes of bacterial diseases were of this nature We now believe that scientists have succeeded in solving these particular problems successfully through the use of the scientific method. There are many problems, such as the cause of cancer and the control of influenza epidemics, for example, that baffle scientists today. We have referred to some of them in this book These and other problems like them are being attacked by scrutiny and careful evaluation of an immense amount of data and testing the hypotheses formulated as a result of the observations. Any day may see the solution of one or more of them

tentatively, not finally Darwin drew conclusions about the causes which he believed had produced changes in living things, but, in so doing, he recognized that he did not possess all the data necessary to justify their unqualified acceptance As a matter of fact, some of his attempted explanations have had to be revised in the light of additional knowledge which has been obtained since his books were written, but his fundamental thesis is more firmly established than ever In this way scientific knowledge advances The truths of yesterday must be made over in the light of present-day knowledge, but progress is made possible because of the successes and failures of those who have preceded us

Personality development and the scientific method If the statements we have been making are true, it follows that one does not have to accept his personality as he finds it, but that it can be made over and improved How may this be done? It is certain that an individual who desires to change his personality cannot do so merely by wishing to have it changed The problem must be attacked by the use of the scientific method

The scientist scrutinizes his problem from various angles and gets as much light upon it as possible Likewise, the person who is serious about improving his personality should try to learn about his own behavior by acquiring a background of knowledge regarding human behavior in general He should examine his weaknesses and strong points objectively What are his automatic ways of acting—those little unconscious habits that can be so unpleasant to others, and perhaps so injurious to himself?

After learning about himself as the result of objective observations he may then do what the scientist does in his researches He may set up certain methods of procedure which, if followed, give promise of accomplishing the aim he has in view, namely, improving his personality in certain specific ways Having learned about the laws of human behavior, he will try to set up situations or create an environment which will call forth the kind of behavior he is desirous of developing It is advisable to con-

centrate on one or two traits at a time rather than to attempt to remake the whole personality at one time

The significance of the scientific method Mental health implies clear thinking and emotional control The characteristics common to mental disorders are that intelligence has gone astray or that emotions are uncontrolled Therefore, there can be no more important attributes of a healthy mind in a healthy body than the wise use of reflective thinking and emotional control The cultivation of these abilities is a hygienic measure of supreme importance both to society and to the individual, provided they are motivated and guided by social insight and human sympathy and understanding The application of adequate methods in the solution of social problems is necessary for the creation of a better society than any the world has yet known

APPENDIX

APPENDIX

REFERENCES AND SUPPLEMENTARY ACTIVITIES

The references listed below are typical of the kind of books that should be available The lists are not intended to be complete It is highly desirable for students to become acquainted with several books in the field of hygiene and sanitation

The text should be supplemented by requiring additional reading and by making use of a variety of enrichment materials and procedures such as those suggested under the headings 'Supplementary Activities" Even in a one hour course the use of preserved and fresh materials, models, charts, lantern slides, and motion pictures adds greatly to interest and effectiveness Naturally, in two- or three hour courses greater use can be made of such materials, along with demonstrations and laboratory exercises Those included herewith are suggestive of the kind of activities that are appropriate

General References

Bossard, J , *Man and His World*, Harper, 1932

Boyd, W , *An Introduction to Medical Science*, Lea and Febiger, 1937

Clendening, L , *The Human Body*, Knopf, 1927

Diehl, H S , *Healthful Living*, McGraw Hill, 1935

Fishbein, M , *Modern Home Medical Adviser*, Doubleday, Doran, 1935

Fisher, L , and Fisk, E L , *How to Live*, Funk and Wagnalls, 1932

Haggard, H A , *Devils, Drugs, and Doctors*, Harper, 1929

Harvey, B , *Simple Lessons in Human Anatomy*, American Medical Association, Chicago, 1931

Meredith, L , *Hygiene, A Textbook for College Students*, Blakiston's Son, 1932

Mustard, H S, *An Introduction to Public Health*, Macmillan, 1935.
Park, W. H, *Public Health and Hygiene*, Lea and Febiger, 1928
Rosenau, M J, *Preventive Medicine and Hygiene*, Appleton-Century, 1935
Sherbon, F B, *The Family in Health and in Illness*, McGraw-Hill, 1937.
Smillie, W G, *Public Health Administration in the United States*, Macmillan, 1935
Tobey, J A, *Cancer and What Everybody Should Know About It*, Knopf, 1932
Hygeia, The Health Magazine, American Medical Association
Publications of the United States Public Health Service, Washington, D. C, and also of state and local health departments

INTRODUCTION

A References

See *General List*

B Supplementary Activities

An acquaintance with the health facilities of the college

CHAPTER I THE ENVIRONMENT

A References

Berry, P G , *Stuff*, Appleton Century, 1930
Bossard, J , *Man and His World*, Harper, 1932, pp 1-55
Furnas, C. C., *The Next Hundred Years*, Williams and Wilkins, 1936
Huntington, E., *The Human Habitat*, Van Nostrand, 1929
Kirkpatrick L A , *The Sciences of Man in the Making*, Harcourt, Brace, 1932, pp 70-86, 271-319, 342-382
Mayer, L , *The Curative Value of Light*, Appleton-Century, 1932
Mills C. A., *Living Along with the Weather*, Caxton, 1934
Newman, H , *The Nature of the World and of Man*, Garden City Publ Co , 1933, chapters I-V
Sedgwick W T , *Sedgwick's Principles of Sanitary Science and Public Health* Macmillan, 1935
Sears, P B , *This Is Our World*, Univ of Okla Press, 1937
Whitbeck, R H , and Thomas, O J , *The Geographic Factor*, Appleton Century, 1932

B Supplementary Activities

Desirable Production of oxygen and carbon dioxide and testing these gases with reference to their ability to support oxidation.

Further suggestions Demonstration of spectrum.

Lantern slides and motion pictures are available that show earth s position in solar system and certain fundamental facts about geography, meteorology and bacteria essential to life

CHAPTER II OUR BODIES

A References

Clendening, L, *The Human Body*, Knopf, 19-7
Hance, R F, *The Machines We Are*, Crowell, 1932
Harvey, B, *Simple Lessons in Human Anatomy*, American Medical Association, 19,1
Textbooks in anatomy, physiology and hygiene

B Supplementary Activities

Desirable Examination of skeleton and of model of human trunk Lantern slides to show systems of the body and comparative anatomy

Further suggestions Demonstration of fetal skeleton of about seven months.

CHAPTER III. THE RISE OF PREVENTIVE MEDICINE

A. References

Beard, E , *Whither Mankind*, Longmans, Green, 1928, Ch. VIII.
Ben Meyr, B , *Your Germs and Mine*, Doubleday, Doran, 1934.
Bossard, J , *Man and His World*, Harper, 1932, pp. 506-572.
Compton, P , *The Genius of Pasteur*, Macmillan, 1932.
De Kruif, P , *Microbe Hunters*, Harcourt, Brace, 1926.
Dublin, L I , and Lotka, A. J , *Twenty-five Years of Health Progress*, Metropolitan Life Insurance Co , 1937.
Moore, H H , *Public Health in the United States*, Harper, 1923.
Roddis, L H , *Edward Jenner and the Discovery of Smallpox Vaccine*, Banta, Menasha, Wisconsin, 1930.
Rosenau, M J , *Preventive Medicine and Hygiene*, Appleton-Century, 1935, pp 137-152, 209-228
Sand, Rene, *Health and Human Progress*, Macmillan, 1936.
Tobey, J A , *Riders of the Plagues*, Scribner, 1920.
Valery-Radot, R , *Life of Pasteur*, Garden City Pub Co , 1924.

B Supplementary Activities

Desirable Demonstration of the growth and appearance of bacteria

Further suggestions Examination of preserved specimens and microscopic slides of pathogenic organisms.

CHAPTER IV POSTURE, EXERCISE AND REST

A References

Hiss, L M, *New Feet for Old*, Doubleday, Doran, 1937
Jacobson, E., *You Must Relax*, McGraw Hill, 1934
Laird, D A, and Muller, C G, *Sleep, Why We Need It and How to Get It*, John Day, 1930
Lane, J, *Your Carriage, Madam*, Wiley, 1934
McCollum, E V, and others, *A Handbook of Positive Health*, Women s Foundation for Health, New York Chs I III, V, VI
Mye, Dorothy, *New Bodies for Old*, Funk and Wagnalls, 1937
"Sleep," *Fortune*, vol 10, p 84, Sept, 1934

B Supplementary Activities

Desirable Examination of skeleton, paying particular attention to the bones of the vertebral column and the feet.

Examination of model of a foot showing ligaments and articulations

Motion pictures and lantern slides demonstrating posture and exercise

Further suggestions Demonstration of fresh material showing bones, tendons, and ligaments

Demonstration of microscopic preparations showing types of muscle cells

Demonstration of electrical stimulation of gastrocnemius muscle of a frog using smoked paper and a kymograph

CHAPTER V AIR AND HOW OUR BODIES USE IT

A References

Diehl, H S, *Healthful Living*, McGraw-Hill, 1935, pp 211-249
Jacobs, P P, *The Control of Tuberculosis in the United States*, National Tuberculosis Association, New York, 1932
Myers, J A., and Shepard, W P, *The Child and the Tuberculosis Problem*, Thomas, 1932
Ventilation, Report of New York State Commission on Ventilation, Dutton, 1925
Winslow, C E. A, *Fresh Air and Ventilation*, Dutton, 1926
Publications of the National Tuberculosis Association.

B Supplementary Activities

Desirable Examination of model of lungs in chest cavity
Demonstration of the use of the spirometer
Lantern slides and motion pictures to show breathing organs and their functioning
Further suggestions Examination of fresh specimen of a hog's lungs
Examination of microscopic preparations of lung tissue

CHAPTER VI THE FOODS WE EAT
and
CHAPTER VII THE DIGESTIVE PROCESS

A References

Aykroyd, W R, *Vitamins and Other Dietary Essentials*, Wm Heinemann, Ltd (London), 1936
Crumbine, S J, and Tobey, J A, *The Most Nearly Perfect Food*, Williams and Wilkins, 1929
Jordan, E O, *Food Poisoning and Food Borne Infections*, University of Chicago, 1931
McCollum, E V, and Simmonds, N, *Newer Knowledge of Nutrition*, Macmillan, 1929
Palmer, B B, *Paying Through the Teeth*, Vanguard Press, 1935
Rose, M S, *Foundations of Nutrition*, Macmillan, 1933
Sherman, H C, *Food and Health*, Macmillan, 1934
Publications of the United States Department of Agriculture

B Supplementary Activities

Desirable Examination of models of the digestive system, including the teeth and a villus

Motion pictures and lantern slides to show the digestive organs and their functioning

Further suggestions Food tests

Demonstration of salivary digestion and the digestion of protein

Examination of prepared specimen of small intestine

Demonstration of digestive tract in an animal, such as a cat or white rat

Formulation of different types of diets

Counting the calories during a week

Demonstration of how foods spoil

Examination of pathogenic organisms that may attack the body through the alimentary tract

CHAPTER VIII DISTRIBUTING SYSTEM OF THE BODY

A References

Babcock, R , *Your Heart and How to Take Care of It*, Appleton-Century, 1929
Cannon, W B , *The Wisdom of the Body*, Norton, 1932
Dublin, L I , and Lotka, A J , *Length of Life*, Ronald Press, 1936
Fortune, Nov , 1937, 'Death Comes to the Average Man" (Heart Disease), Vol XVI, No 5, p 140
Harvey, W , *The Motion of the Blood in Animals*, Dutton, 1923
Levin, L , *Living Along with Heart Disease*, Macmillan, 1935

B Supplementary Activities

Desirable Examination of model of the heart
Examination of fresh heart of ox.
Taking the pulse before and after exercise
Demonstration of circulation in the web of a frog's foot.

Further suggestions Microscopic examination of blood
Demonstration of circulatory system in preserved animal like the cat
Demonstration of determining hemoglobin index and of coagulation time in clotting of blood
Lantern slides and motion pictures

CHAPTER IX EXCRETION AND THE SKIN

A References

Chandler, H, *Animal Parasites and Human Diseases*, Wiley, 1926, pp 147-167, 438 449

Luckiesch, M, and Pacini, A J, *Light and Health*, Williams and Wilkins, 1936

Phillips, M C, *Skin Deep*, Vanguard Press, 1934

Pusey, W, *Care of the Skin and Hair*, Appleton Century, 1929

— *The History of Dermatology*, Thomas, 1933

Strickler, A, *The Skin Its Care and Treatment*, Appleton-Century, 1927

B Supplementary Activities

Desirable Examination of models of the kidneys and skin
Examination of prepared specimen of a kidney or a fresh specimen

Further suggestions Examination of microscopic slide showing parts of the skin

CHAPTER X CONTROL AND INTEGRATION OF BODILY ACTIVITIES

A References

Bossard, J, *Man and His World*, Harper, 1932, pp 273-333
Burnham, W H, *The Normal Mind*, Appleton Century, 1924
Cannon, W B *Bodily Changes in Pain, Hunger, Fear, and Rage*, Appleton Century, 1929
Hoskins, R C, *The Tides of Life*, Norton, 1923
Kirkpatrick, E A, *The Sciences of Man in the Making*, Harcourt, Brace, 1932, pp 176 206
Merrill, H G, and Oaks, L W, *Your Vision and How to Keep It*, Putnam, 1931
Robinson, E S, *Man as Psychology Sees Him*, Macmillan, 1932
Publications of the National Association for the Prevention of Blindness, New York
Publications of the American Society for the Hard of Hearing, 1537 35th Street, N W, Washington, D C

B Supplementary Activities

Desirable Examination of models of the brain, spinal cord, eye, and ear

Motion pictures and lantern slides

Dissection of eye of ox

Further suggestions Examination of preserved or fresh specimens of brain and spinal cord

Examination of microscopic slides of brain, spinal cord, nerve, and receptors of eye, ear, and tongue

CHAPTER XI THE CONTINUATION OF LIFE

A References

Altenberg, E., *How We Inherit*, Holt, 1928
Bigelow, M A, *Sex Education*, American Social Hygiene Association, 1936
de Schweinitz, C., *Growing Up*, Macmillan, 1936
East, E M, *Heredity and Human Affairs*, Scribner, 1931
Gruenberg, B C., *Parents and Sex Education*, Viking Press, 1932
Guttmacher, A F, *Into This Universe*, Viking Press, 1937
Kirkpatrick, E. A, *The Sciences of Man in the Making*, Harcourt, Brace, 1932, pp 93 116
Parran, T, *Shadow on the Land*, Reynal and Hitchcock, 1937
Parshley, H M, *The Science of Human Reproduction*, W W Norton, 1933
Pusey, W A, *The History and Epidemiology of Syphilis*, Thomas, 1933
Richmond, W, *An Introduction to Sex Education*, Farrar and Rinehart, 1923
Snow, W F, *Venereal Disease*, Funk and Wagnalls
Publications of the American Social Hygiene Association, New York

B Supplementary Activities

Desirable Models and charts of the reproductive organs

CHAPTER XII. MENTAL HEALTH

A References

Bossard, J, *Man and His World*, Harper, 1932, pp 251-366.
Campbell, C M, *Delusion and Belief*, Harvard Univ. Press, 1926
Groves, E R, and Blanchard, P, *Introduction to Mental Hygiene*, Holt, 1930
— *Readings in Mental Hygiene*, Holt, 1936
Kirkpatrick, E A, *The Sciences of Man in the Making*, Harcourt, Brace, 1932, pp 1-23, 207 270
Morgan, J, *Keeping a Sound Mind*, Macmillan, 1934.
Robinson, J H, *The Mind in the Making*, Harper, 1921.
Seabury, D, *Help Yourself to Happiness*, McGraw-Hill, 1937.
Shaffer, L F, *The Psychology of Adjustment*, Houghton Mifflin, 1936
Wallin, J, *Personality Maladjustment and Mental Hygiene*, McGraw-Hill, 1935
Publications of the National Committee for Mental Hygiene

B *Supplementary Activities*

Desirable A visit to a mental hygiene clinic or a child guidance clinic

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